

NOAA-K, -L, -M
Data Formats
and
Instrument Data Parameters

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Preface

The Advanced TIROS-N K through N' series of satellites is the fourth variation of the latest generation of polar orbiting operational environmental satellite systems. The design of this series is based on the Advanced TIROS-N H-I-J satellites with significant modifications and additions to the Attitude Control System, the Power System, and the S-Band Command System. Enhancements have also been made to the Instrument Payload: the Advanced Microwave Sounding System will replace the Microwave and Stratospheric Sounding Units, and modifications have also been made to the Advanced Very High Resolution Radiometer, the Data Collection System, the Solar Environment Monitor, and the Search and Rescue Processor.

In addition, the Titan II launch system will be used to place the K, L, and M satellites into a sun synchronous polar orbit and the Delta 2 launch system will place the N and N' satellites into a similar orbit.

The official NOAA-K, -L, and -M Telemetry List (LMAS document 20022517) is included as an appendix to this report.

These satellites are expected to be launched during the mid to late nineties time period.

This report is not a controlled document. Formats described herein are correct as of April 1996.

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Section 1. NOAA-K, -L, -M Spacecraft and Instruments

1.1 Introduction

A new series of operational environmental satellites will begin with the successful launch of NOAA-K. NOAA-K, -L, -M, -N, and -N' will be the successors to the current NOAA operated, polar orbiting satellites.

These new satellites will carry a series of instruments which have been modified and improved from those now in orbit.

The Advanced Very High Resolution Radiometer (AVHRR/2) has been modified. The new instrument, AVHRR/3, adds a sixth channel in the near-IR, at 1.6 microns. This will be referred to as Channel 3A and will operate primarily during the daylight part of the orbit. Channel 3B corresponds to the previous Channel 3 on the AVHRR/2 instrument. A flag in the telemetry will indicate which of the two channels is operating. Splitting channel 3 in this way maintains the High Resolution Picture Transmission (HRPT) data format, which was designed to handle five AVHRR channels. Channels 3A and 3B are output at the same telemetry location.

The Microwave Sounding Unit (MSU) and Stratospheric Sounding Unit (SSU) instruments have been deleted. NOAA-K will fly with Advanced Microwave Sounding Units (AMSU-A1, AMSU-A2, and AMSU-B). The AMSU-A is a 15-channel microwave radiometer in two separate units. For AMSU-A1 and -A2, the word 0001 (Hexadecimal (H)) will be used as fill data most of the time in the telemetry stream. The new AMSU data is expected to provide improved temperature and humidity soundings. Additionally, window channels 1, 2, and 15 will provide information on precipitation, sea ice and snow cover. The AMSU-B is a five-channel microwave radiometer; three of which are centered on the 183.31 GHz water vapor line. The other two channels are at 89 GHz and 150 GHz. For AMSU-B, the word 5555H will be used as fill data most of the time in the telemetry stream.

The Solar Backscatter Ultraviolet Radiometer (SBUV) is carried on satellites in an afternoon orbit. NOAA-K is anticipated to be launched into a morning orbit and will not carry the SBUV/2, which has only minor changes from similar instruments carried on previous spacecraft.

The new High Resolution Infrared Radiation Sounder (HIRS/3) will have the calibration sequence changed. On HIRS/2, the calibration mode required the use of three calibration targets (space view, cold target and warm target). On HIRS/3, the cold target will not be routinely used in the calibration sequence, resulting in one additional scan line available for Earth data (38 Earth scans per each 256 second cycle).

The Argos Data Collection System (DCS) aboard the NOAA polar orbiting satellites will be

improved for NOAA-K. The DCS/2 will have an increased data transmission rate (from 1200 to 2560 bits per second) and the onboard data recovery units (DRU) will be increased from four to eight.

An improved Space Environment Monitor (SEM) has added inflight calibration capabilities and improved particle detection.

The Search and Rescue Processor (SARP) has added capabilities for the handling of distress messages, as well.

With the new instruments, data formats will be changed. Within the HRPT Minor Frame, the first Minor Frame will be TIP data, the second Minor Frame will be spare, and the third Minor Frame will be AMSU-A1, -A2, and -B data.

Within the TIP Minor Frame (orbital mode format), the deletion of the MSU and SSU instruments will make available several words. DCS/2 data will now be contained in additional words 18, 19, 24, 25, 32, 40, 41, 44, 45, 61, 68, 69, 76, 77, 86, and 87. HIRS/3 data will move from words 14/15 to 16/17. Word 102 will be a spare.

As noted above, the third HRPT Minor Frame will contain AMSU data. The AMSU information processor (AIP) inputs data from the three AMSU instruments and the TIP. This Minor Frame will contain 208 words. In summary, words 8 through 33 will contain AMSU-A1 data, words 34 through 47 will contain AMSU-A2 data, and words 48 through 97 will contain AMSU-B data.

1.2 Purpose

This information is provided to users of NOAA polar orbiting satellite data as an indication of the changes in the NOAA-K through M series. However, this information is preliminary in nature, and subject to revision prior to NOAA-K becoming operational.

1.3 Scope

The remainder of this document consists of two sections and an appendix:

Section 2: NOAA-K, -L, -M Telemetry Frame Formats

Section 3: NOAA-K, -L, -M Instrument Telemetry Data Parameters.

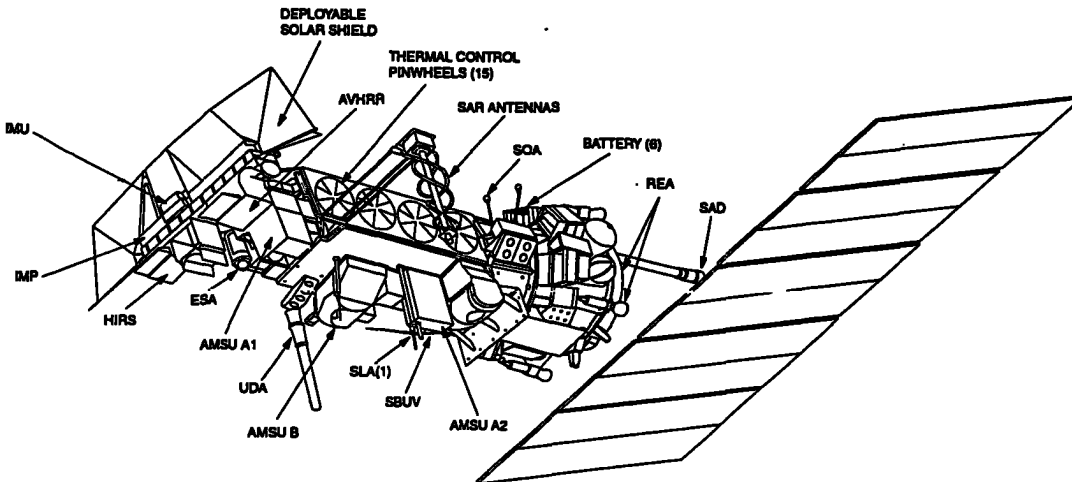
Appendix: NOAA KLM Telemetry List

Table 1-1. NOAA-K, -L, -M Spacecraft Characteristics and Performance
(1 of 2)

Parameter	Description
Lifetime	Greater than 2 years
Operational Sun Angle	0 to 80 degrees
Configuration	Multi-sectioned stack
Size	4.19 m long x 1.88 m in diameter (165 inches x 74 inches)
Weight (Normal, On-orbit)	Approximately 1475.0 Kg (3251.8 lbs)
Attitude Control	Zero momentum Earth stabilized Earth and solar reference Reaction wheel control Magnetic Unloading, GN ₂ Backup
Control Accuracy	< \pm 0.2 degrees
Knowledge with Ground Processing	< \pm 0.1 degrees
Rates	< \pm 0.035 degrees/second pitch < \pm 0.035 degrees/second yaw < \pm 0.015 degrees/second roll
Launch Vehicle	Titan II (K, L, M)
Orbit Attainment	Spacecraft navigation from liftoff Titan II guidance and control up through separation Apogee velocity kick Spacecraft V trim 833 km (450 NMi) morning orbit 870 km (470 NMi) afternoon orbit
Reaction Control	N ₂ (2-Lb. thrust) (8.9 N) N ₂ H ₄ (98-Lb. thrust) (435.9 N)
Thermal Control	Passive (blankets, finishes, materials) Active (pinwheel and vane louvers, heaters)

Table 1-1. NOAA-K, -L, -M Spacecraft Characteristics and Performance (2 of 2)

Parameter	Description
Power	Direct energy transfer Partial shunt array control Boost discharge 870 watts orbit average max. load power available at 2-year End of Life (EOL) at 80 degrees sun angle, 880 watts at 0 degrees sun angle
Solar Array	2.37 m x 4.91 m: 11.64 square meters (7.8 ft x 16.1 ft: 125.6 square feet)
Command	S-Band, Non-return to Zero (NRZ)-M 2026.0 MHz Phased Modulated Carrier, 16 kHz Subcarrier Frequency BPSK Modulation Data Rate is 2 kb/sec
Command Capacity	1200 real time (approx. 360 implemented) 2300 stored
Communications	Beacon: 137.35 and 137.77 MHz, 1.0 watts EOL APT: 137.5 and 137.62 MHz, 5 watts EOL S-band: 1698 MHz, 6.35 watts EOL S-band: 1702.5 MHz, 6.35 watts EOL S-band: 1707 MHz, 6.35 watts EOL Command Receiver: 2026.0 MHz DCS Receiver: 401.65 MHz S-band TLM: 1702.5 MHz S-band Ascent and Emergency: 2247.5 MHz, 5.25 watts EOL SARP Receiver: 406.05 MHz SARR Receiver: 121.5 MHz, 243 MHz, 406.05 MHz SAR: 1544.5 MHz
Instrument Complement	Advanced Very High Resolution Radiometer (AVHRR/3) High Resolution Infrared Radiation Sounder (HIRS/3) Advanced Microwave Sounder Unit (AMSU-A1, -A2, -B) Data Collection System - ARGOS (DCS-2) Space Environment Monitor (SEM-2) Search and Rescue (SAR) Satellite Aided Tracking (SARR, SARP) Solar Backscatter Ultraviolet Radiometer (SBUV/2) (Only on PM spacecraft)



LEGEND	
AMSU	ADVANCED MICROWAVE SOUNDING UNIT
AVHRR	ADVANCED VERY HIGH RESOLUTION RADIOMETER
ESA	EARTH SENSOR ASSEMBLY
HIRS	HIGH RESOLUTION INFRARED SOUNDER
IMP	INSTRUMENT MOUNTING PLATFORM
IMU	INERTIAL MEASUREMENT UNIT
REA	REACTION ENGINE ASSEMBLY
SAD	SOLAR ARRAY DRIVE
SAR	SEARCH AND RESCUE
SBUV	SOLAR BACKSCATTER ULTRAVIOLET SOUNDING SPECTRAL RADIOMETER
SOA	S-BAND OMNI ANTENNA
SLA	SEARCH AND RESCUE TRANSMITTING ANTENNA (L BAND)
UDA	ULTRA HIGH FREQUENCY DATA COLLECTION SYSTEM ANTENNA
VRA	VERY-HIGH FREQUENCY REALTIME ANTENNA

Figure 1-1. NOAA-K, -L, -M Spacecraft

Table 1-2. NOAA-K, -L, -M, -N, and -N' Spacecraft Addresses

<u>Satellite</u>	<u>TLM</u>	<u>Bits</u>	<u>Hex</u>	<u>MIRP</u>
NOAA-K	Tip 1	0111	(7)	0111 (7)
	2	1000	(8)	
NOAA-L	Tip 1	1001	(9)	1001 (9)
	2	1010	(A)	
NOAA-M	Tip 1	1011	(B)	1011 (B)
	2	1100	(C)	
NOAA-N	Tip 1	1101	(D)	1101 (D)
	2	1110	(E)	
NOAA-N'	Tip 1	1111	(F)	1111 (F)
	2	0000	(0)	

Note: The spacecraft address is contained in TIP Minor Frame Word 2 (Figure 2-1) and in AIP Minor Frame Word 105 (Figure 2-2).

Section 2

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Section 2. NOAA-K, -L, -M Telemetry Frame Format

2.1 Introduction

This section contains frame formats in block form and a description, word counts, and location of telemetry words for the TIROS Information Processor (TIP), AMSU Information Processor (AIP), Manipulated Information Rate Processor (MIRP), High Resolution Picture Transmission (HRPT), and Automatic Picture Transmission (APT).

Frame formats are contained in the following subsections:

2.2 TIP Frame Format

2.3 AIP Frame Format

2.4 MIRP Frame Format

2.4.1 GAC Format

2.4.2 HRPT/LAC Format

2.4.3 APT Format

2.2 Advanced TIROS Information Processor (TIP) Frame Format

About one-quarter of the 104 telemetry word locations in the TIROS information Processor (TIP) minor frame format have been changed. This is due to the removal of the Stratospheric Sounding Unit (SSU) and the Microwave Sounding Unit (MSU) from the instrument payload. Word locations previously assigned have been allocated to the High Resolution Infrared Sounder (HIRS/3) and Data Collection System (DCS-2). In addition, two words have been allocated to the Decryption Authentication Unit (DAU). No changes have been made to the transmission characteristics i.e., radiated power and data rate.

Figure 2-1 shows the telemetry word locations in a frame format. Table 2-1 contains telemetry word titles, locations within the frame, and word descriptions in tabular form.

1 Bit: CMD VER Status		2 Bits: TIP Status		3 Bits: Major Frame Counter			Frames 0 - 319 *				
0	1	2	3	4	5	6	7	8	9	10	11
11101101	11100010	0000	4-Bit S/C ID	4 9 Bit Dwell Address	5 9 Bit Subcom Counter	CMD Verification Data		DIG-B Subcom (3.2 Sec)	Analog Subcom (32 Sec)	Analog Subcom (16 Sec)	Analog Subcom (1.0 Sec)
12	13	14	15	16	17	18	19	20	21	22	23
DIG-B Subcom (32 Sec)	Analog Subcom (16 Sec)	DAU-1	DAU-2	HIRS/3	HIRS/3	DCS-2	DCS-2	SEM	HIRS/3		
24	25	26	27	28	29	30	31	32	33	34	35
DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	HIRS/3	
36	37	38	39	40	41	42	43	44	45	46	47
SBUV/2	HIRS/3	HIRS/3	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	CPU-A Telemetry	
48	49	50	51	52	53	54	55	56	57	58	59
CPU-A Telemetry	CPU-A Telemetry	CPU-A Telemetry	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	HIRS/3	
60	61	62	63	64	65	66	67	68	69	70	71
DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	HIRS/3	
72	73	74	75	76	77	78	79	80	81	82	83
DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	SBUV/2	HIRS/3	HIRS/3	
84	85	86	87	88	89	90	91	92	93	94	95
HIRS/3	DCS-2	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	DCS-2	HIRS/3	HIRS/3	DCS-2	
96	97	98	99	100	101	102	103	* Minor Frame Period: 0.1 sec. Major Frame Period: 32 sec. Output Data Rate: 8.32 kbps.			
			CPU-B Telemetry			SPARE 01010101	6-Bits Even Parity				

Notes: Number in upper left-hand corner indicates Minor Frame word number.
 - Time code data appears during Minor Frame "0", word location 8 through 12

Figure 2-1. Orbit Mode

Table 2-1 TIP Minor Frame Format (1 of 3)

Function	No. of Words	Word Position	Bit Number								Plus Word Code & Meaning
			1	2	3	4	5	6	7	8	
Frame Sync & S/C ID	3	0 1 2	1	1	1	0	1	1	0	1	The last 4 bits of word 2 are used for spacecraft identification
Status	1-	3	<p>Bit 1: Command Verification (CV) Status: 1 = CV update word present in frame ; 0 = no CV update in frame.</p> <p>Bits 2 & 3: TIP Status: 00 = orbital mode, 10 = Central Processor Unit (CPU) Memory Dump Mode, 01 = Dwell Mode, 11 = Boost Mode</p> <p>Bits 4-6: Major Frame Count: 000 = Major Frame 0, 111 = Major Frame 7, MSB first; Counter incremented every 320 minor frames.</p>								
Dwell Mode Address	1+	3 4	<p>Bits 7 & 8: 9 bit dwell mode address of analog channel that is being monitored continuously</p> <p>Bits 1-7: 0 0 0 0 0 0 0 0 = Analog channel 0 1 0 1 1 1 0 1 0 1 = Analog channel 383, MSB first</p>								
Minor Frame Counter	1+	4 5	<p>Bit 8: 0 0 0 0 0 0 0 0 0 = Minor Frame 0</p> <p>Bit 1-8: 1 0 0 1 1 1 1 1 1 = Minor Frame 319, MSB first</p>								
Command Verification	2	6 7	Bit 9 thru 24 of each received command word are placed in the 16 bit slots of telemetry words 6 and 7 on a one-for-one basis.								
Time Code	5	8,9 9 9, 10, 11, 12	<p>9 bits of Binary Day Count, MSB first</p> <p>Bits 2-5: 0101; Spare bits</p> <p>27 bits of Binary Millisecond of Day Count, MSB first</p> <p>Time code is inserted in word location 8-12 only in minor frame 0 of every major frame. The data inserted is referenced to the beginning of the first bit of the minor frame sync word of minor frame 0.</p>								
Digital B Subcom	1	8	A subcommutation of Discrete inputs collected to form 8 bit words. 256 Discrete inputs (32 words) can be accommodated. It takes 32 minor frames to sample all inputs once (sampling rate = once per 3.2 sec). A major frame contains 10 complete Digital B subcommuted frames.								

Table 2-1 TIP Minor Frame Format (2 of 3)

Function	No. of Words	Word Position	Bit No.	Plus Word Code & Meaning			
			1 2 3 4 5 6 7 8				
32 Sec Analog Subcom	1	9	A subcommutation of up to 192 analog points sampled once every 32 seconds plus 64 analog points sampled twice every 32 seconds (once every 16 seconds). Bit 1 of each word represents 2560 mv while Bit 8 represents 20 mv.				
16 sec Analog Subcom	1	10	These two subcoms are under Programmed, Read Only Memory (PROM) control. A maximum of 128 analog points can be placed in the 169 slots; super commutation of some selected analog channels will be done in order to fill the 169 time slots. The 170th slot is filled with data				
1 sec Analog Subcom	1	11	from the analog point selected by command. The slot is word number zero of the one second subcom. The analog point may be any of the 384 analog points available. Bit 1 of each word represents 2560 mv while Bit 8 represents 20 mv.				
DIG B Digital Subcom (3.2 sec)	1	12	Spacecraft status telemetry in subcommutated form for analysis by ground satellite controllers.				
Analog Telemetry (16 sec)	1	13	Analog housekeeping telemetry points converted to digital values for ground controller analysis.				
Spares	1	102	01010101				
SBUV/2	2	36,37 80,81	8 bit words are formed by the SBUV/2 instrument and are read out by the telemetry system at an average rate of 40 words per second.				
DAU -1, -2	2	14 15	8 bit words are formed by the DAU and are read out by the telemetry system at an average rate of 20 words per second.				
HIRS/3	36	16,17,22 23,26,27 30,31,34 35,38,39 42,43,54 55,58,59 62,63,66 67,70,71 74,75,78 79,82,83 84,85,88 89,92,93	8 bit words are formed by the HIRS/3 instrument and are read out by the telemetry system at an average rate of 20 words per second				

Table 2-1 TIP Minor Frame Format (3 of 3)

Function	No. of Words	Word Position	Bit No.	Plus Word Code & Meaning
			1 2 3 4 5 6 7 8	
SEM-2	2	20 21	8 bit words are formed by the SEM and are read out by the telemetry system at an average rate of 20 words per second	
DCS-2	32	18,19,24 25,28,29 32,33,40 41,44,45 52,53,56 57,60,61 64,65,68 69,72,73 76,77,86 87,90,91 94,95	8 bit words are formed by the DCS and are read out by the telemetry system at an average rate of 20 words per second	
CPU-A TLM	6	46,47,48 49,50,51	A block of three 16 bit CPU words is read out by the telemetry system every minor frame from CPU-A.	
CPU-B TLM	6	96,97,98 99,100 101	A block of three 16 bit CPU words is read out by the telemetry system every minor frame from CPU-B.	
CPU Data Status	1-	103	Bits 1 & 2: 00 = All CPU data received 01 = All CPU-A data received; CPU-B incomplete 10 = All CPU-B data received; CPU-A incomplete 11 = Both CPU-A and CPU-B incomplete	
Parity	1-	103	Bit 3: Even parity check on words 2 through 18 Bit 4: Even parity check on words 19 through 35 Bit 5: Even parity check on words 36 through 52 Bit 6: Even parity check on words 53 through 69 Bit 7: Even parity check on words 70 through 86 Bit 8: Even parity check on words 87 through bit 7 of word 103	

2.3 Advanced Microwave Sounding Unit (AMSU) Information Processor (AIP)

The AMSU Information Processor (AIP) generates a data stream consisting of AMSU data and TIP Orbit mode data as shown in Figure 2-2. The AIP output data rate for this data product is 16.64 kbps. This data is available to the Cross Strap Unit (XSU) in both NRZ-L and bi-phase formats separately.

2.3.1 AMSU Data

The AIP continuously generates a data stream consisting exclusively of AMSU data. This data stream's format is shown in Figure 2-2 as word 0 through 103. The AIP output data rate for this data product is an average of 8.32 kbps. It is sent at a 16.64 kbps rate, but only the first half of the AIP frame is received by the Manipulated Information Rate Processor (MIRP). This data is available to the MIRP in NRZ-L.

2.3.2 TIP Data

The AIP inputs TIP data, in both NRZ-L and bi-phase format, from the TIP at a rate of 8.32 kbps (for TIP orbit, dwell, and CPU dump mode) or 16.64 kbps (for TIP boost mode). Upon command, the AIP outputs TIP bi-phase data and AMSU/TIP NRZ-L data, or TIP data in both NRZ-L and bi-phase formats, to the XSU, without any processing.

Minor Frame Period - 0.1 Sec/Output Data rate - 16.64 Kbps

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
22 Bit Synch	1	///	///	Minor Frame Ctr	See Note	///	///	///	///	///	///	///	///	AMSU-A1	///	///	///	///	///	///	///	///	///
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1	AMSU-A1
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B	AMSU-B
120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3
144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167
DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2
168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2	DCS -2
192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215
HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3	HIRS /3
<div> <div>1-Bit CV Stat</div> <div>1-Bit TIP Stat</div> <div>3-Bit Major Frame Counter</div> </div> <div> <div>Note 1: Word 106</div> <div>Note 2: Words 206/207</div> </div>																							

Notes: Number in upper portion indicates Minor Frame word number.

Last two bits of Word 2 are "00"

/// indicates "Spare" and reads 01010101 etc.

Words 103 through 206 are as TIP Orbit Mode

Telemetry Words 0 through 103 (Minor Frame).

Word 5: First six bits are 000000; last two bits are the 8-Second Frame Counter.

2-Bit CPU Data Status								6-Bit TIP Parity								6-Bit AIP Parity							
/								///								///							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

Note 2: Words 206/207

Figure 2-2. AIP Output Format

2.3.3 Communication of Digital Inputs

2.3.3.1 AMSU Data

The AIP provides commutation and formatting capability for the three AMSU instruments, AMSU-A1, AMSU-A2 and AMSU-B. These channels are commutated and formatted as shown in Figure 2-2. Each AMSU interface consists of a data line which is presented to the AIP by the AMSU, and a continuous clock line at 16.64 kHz, a select interval line, and a sync signal which are presented by the AIP to the AMSU to permit data transfer. The AIP does not interrogate the AMSU-B for data one minor frame prior to, nor one minor frame after the 8 second sync. The AIP backfills these two minor frames with alternating one's and zero's (Hex A's). Due to a one minor frame delay of AMSU-B data within the AIP, the two minor frames with backfill in place of AMSU-B data are the first two minor frames output by the AIP in the AIP data stream relative to the 8 second sync.

Digital information is accepted during the select interval. When not selected, the AMSU data source is in either an active or inactive state. The users first (most significant) bit of information is established; i.e., reached 90% of its value, at the first negative going transition of the first clock pulse after the AMSU Select Interval goes active. The second through sixteenth most significant bits are established by the negative going transition of the remaining fifteen shift pulses. These bits will remain at their levels until the next negative going transition of the next shift pulse. Data is clocked into the AIP on the positive going transition of the clock pulse. The select signal generated by the AIP is pulsed at the end of the sixteenth bit time if more data words are to be read from the selected AMSU. The signal will go to its inactive level after all words are read.

The AMSU Data multiplexer is designed such that a single first level multiplexer failure does not contaminate more than one AMSU Data input channel. Each AMSU instrument receives control signals on single cross-strapped output lines.

Spare AMSU Data word locations, as shown in Figure 2-2, contain an alternate 0/1 pattern at the AIP output data rate.

2.3.3.2 TIP Data

The AIP inputs TIP data at the TIP data rate of 8.32 kbps. This data is inserted in to the AIP minor frame words 103 through 206 and is identical to TIP frame words 0 through 103.

2.3.4 Generation of Special Digital Words

The AIP generates the digital words specified in this paragraph and inserts them properly into the formatted serial output bit stream.

2.3.4.1 Minor Frame Sync

While in any mode, except ALL TIP mode, the AIP generates a 22-bit sync code at the beginning of each minor frame as shown in Figure 2-2. The AIP outputs the following sequence with the most significant bit first.

	<i>Minor Frame Word 0</i>	<i>Minor Frame Word 1</i>	<i>Minor Frame Word 2</i>	
MSB	11110011	01101010	000000	LSB

During ALL TIP mode the AIP does not generate a sync code.

2.3.4.2 Minor Frame Counter

The AIP generates a count of minor frames which occurs once every 0.1 sec. The counter contains an eight-bit binary representation of the minor frame count and is inserted into the minor frame format as shown in Figure 2-2. Code 0000000 represents Minor Frame 0 and Code 01001111 represents Minor Frame 79. When inserted in the minor frame format, the MSB is first. The minor frame counter is updated at the beginning of each minor frame and resets at the end of Minor Frame 79.

2.3.4.3 Major Frame Counter (8 second frame counter)

The AIP generates a count of major frames which occurs every 80 minor frames. Bits 7 and 8 of minor frame word 5 counts 8-second intervals, the count overflowing to 0 synchronous with the TIP 32-second major frame pulse.

2.3.4.4 AMSU Data Parity

Bits 3 through 8 of Minor Frame Word 102, as shown in Figure 2-2, are used for an even parity check on AMSU Data. The bits have the following interpretation:

<i>Bit</i>	<i>Interpretation</i>
3	Even parity check on data contained in Minor Frame Words 2 through 18.
4	Even parity check on data contained in Minor Frame Words 19 through 35.
5	Even parity check on data contained in Minor Frame Words 36 through 52.
6	Even parity check on data contained in Minor Frame Words 53 through 69.
7	Even parity check on data contained in Minor Frame Words 70 through 86.
8	Even parity check on data contained in Minor Frame Words 87 through 101 includes Bits 1 through 7 of Minor Frame Word 102.

2.3.4.5 TIP Data Parity

Bits 3 through 8 of Minor Frame Word 207, as shown in Figure 2-2 are used for an even parity check on TIP Data. The bits have the following interpretation:

<i>Bit</i>	<i>Interpretation</i>
3	Even parity check on data contained in Minor Frame Words 105 through 121.
4	Even parity check on data contained in Minor Frame Words 122 through 138.
5	Even parity check on data contained in Minor Frame Words 139 through 155.
6	Even parity check on data contained in Minor Frame Words 156 through 172.
7	Even parity check on data contained in Minor Frame Words 173 through 189.
8	Even parity check on data contained in Minor Frame Words 190 through 205 includes Bits 1 through 7 of Minor Frame Word 206.

This parity word amounts to a recalculation of the TIP parity which was calculated by the TIP (AIP word 206).

2.3.5 Pulse Discrete Commands

The CIU provides the AIP with pulse discrete command lines for the purpose of selecting which side of the redundant AIP is to be placed into operation and what AIP mode is to be used. The command lines are specified as follows:

- a. Select AIP 1 not 2
- b. Select AIP 2 not 1
- c. Select AIP data mode
- d. Select TIP bi-phase data mode
- e. Select ALL TIP data mode

2.3.5.1 AIP Modes

The AIP will operate in one of three modes for data output:

1. AIP data mode
2. TIP bi-phase data mode
3. ALL TIP data mode

Modes 1, 2, and 3 are selected by commands c, d, and e respectively from the above

command listing. Table 2-2 displays the AIP modes and their corresponding data outputs.

Table 2-2 AIP Modes

Mode	Command	Data Outputs		
		Bi-Phase Data to XSU	NRZ Data to XSU	NRZ Data to MIRP
AIP Data	Select AIP Data Stream	AMSU/TIP Data Combined	AMSU/TIP Data Combined	AMSU Data Only
TIP Bi-phase Data	Select TIP Bi-phase Data Stream	TIP Data Only	AMSU/TIP Data Combined	AMSU Data Only
ALL TIP data (used for TIP Boost mode)	Select ALL TIP data Streams	TIP Data Only	TIP Data Only	AMSU Data Only

2.3.5.2 Recommended AIP/TIP Commanding Sequence

The ALL TIP mode of the AIP is designed to be used with the TIP Boost Mode, in which TIP data is output at 16.64 kbps. TIP data frames are then received by the AIP twice as fast. The AIP should be commanded into the ALL TIP mode before the TIP is put into boost mode, and commanded out of ALL TIP mode after the TIP leaves boost mode. Due to the transition from an AIP mode to ALL TIP mode, and from ORBIT mode to BOOST mode, the data contained in one minor frame may be corrupted during these transitions.

2.4 Manipulated Information Rate Processor (MIRP) Frame Format

The MIRP outputs the Global Area Coverage (GAC) format simultaneously with the High Resolution Picture Transmission (HRPT), Local Area Coverage (LAC) and Automatic Picture Transmission (APT) formats.

2.4.1 Global Area Coverage (GAC) Format

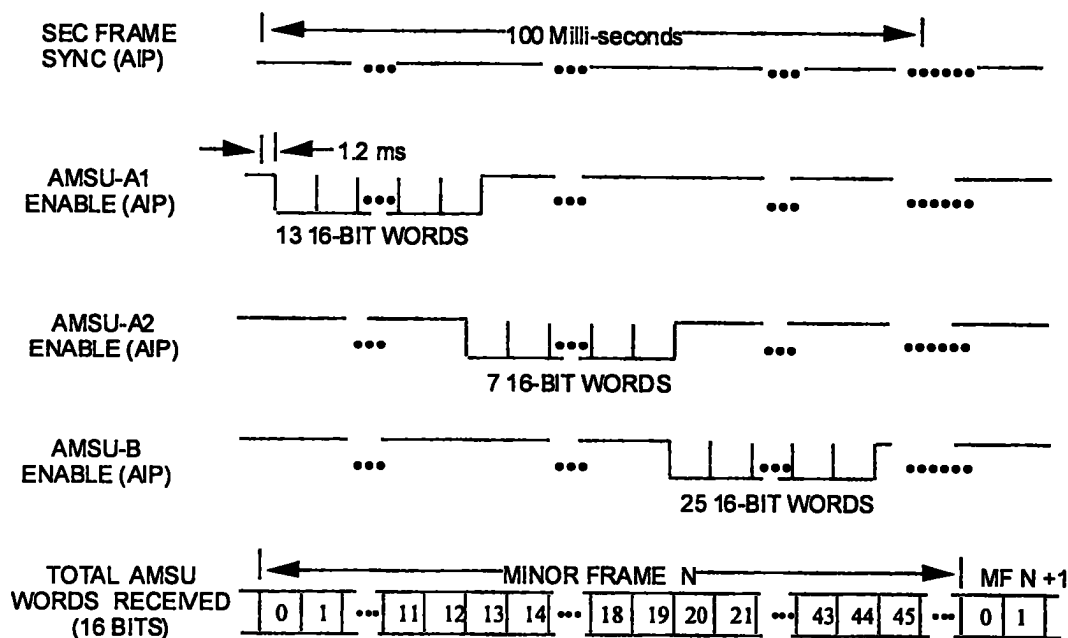
It is a serial PCM bit stream, 10-bit words, most significant bit first. Bit rate is 66,540 bps, word rate is 6,654 w/s. A frame length consists of 3,327 words. The GAC format uses data from every third AVHRR scan.

Figure 2-4 shows the MIRP GAC Frame Formats. Table 2-3 contains telemetry word titles, locations within the frame and word description in tabular form.

The GAC data output is randomized, as shown in Figure 2-5. Beginning at word 7 and continuing through word 3,327, the GAC data is exclusively OR'ed with the complemented output of the 10th degree polynomial generator. The P-N generation is initialized to all "1" state at the beginning of word 7 in each output frame.

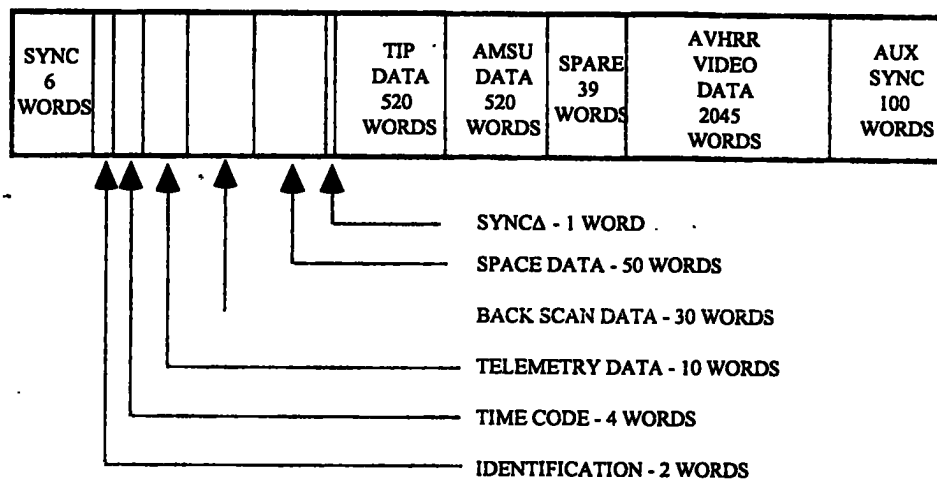
In the MIRP substitution mode, formats are identical as shown in Figure 2-4 and Table 2-3; except the MIRP substitutes data from the polynomial generator instead of the data on the ten AVHRR data lines.

The LAC data output is randomized, as shown in Figure 2-5. Beginning at word 7 and continuing through word 10,990, the LAC data is exclusively OR'ed with the complemented output of the 10th degree P-N generator. The P-N generator is initialized to the all "1" state at the beginning of word 7 in each output frame.



NOTE: The AMSU-B data is not available during all 80 minor frames. (Refer to Para. 2.3.3.1)

Figure 2-3. AIP/AMSU Data Input Sequence



NOTES:

- (1) MINOR FRAME LENGTH - 3,327 WORDS
- (2) FRAME RATE - 2 FRAMES/SECOND
- (3) WORD LENGTH - 10 BITS
- (4) SPARE WORDS SHALL BE DATA "0"
- (5) WHERE BIT CONTENTS OF WORDS ARE SPECIFIED (AS IN NOTE 4),
THE SPECIFICATION APPLIES PRIOR TO DATA RANDOMIZING

Figure 2-4. GAC Frame Format

Table 2-3. GAC Frame Format (1 of 2)

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 9 10 Plus Word Code & Meaning
Frame Sync	6	1 2 3 4 5 6	1 0 1 0 0 0 0 1 0 0 0 1 0 1 1 0 1 1 1 1 1 1 0 1 0 1 1 1 0 0 0 1 1 0 0 1 1 1 0 1 1 0 0 0 0 0 1 1 1 1 0 0 1 0 0 1 0 1 0 1 See Note 1
ID	2	7 8	Bit 1: 0 = Internal Sync; 1 = AVHRR Sync Bit 2 & 3: 00 = identifies Frame as GAC Frame BITS 4-7: Spacecraft Address: Bit 4 = MSB, Bit 7 = LSB Bit 8: 0 = Frame Stable; 1 = Frame Resync Occurred Bit 9: 0 = PN AVHRR input; 1 = Normal AVHRR input Bit 10: 0 = AVHRR CH3A; 1 = AVHRR CH3B Bits 1-10: Spare - undefined
Time Code	4	9 10 11 12	Bits 1-9: Binary day count; Bit 1 = MSB; Bit 9 = LSB; Bit 10: 0 - spare Bits 1-3: 101 - spare Bits 4-10: Part of Binary msec of day count; Bit 4 = MSB Bits 1-10: Part of Binary msec of day count Bits 1-10: Remainder of Binary msec of day count; Bit 10 = LSB
Telemetry	10	13 14 15 16 17 18 19 20 21 22	Ramp Calibration AVHRR Channel #1 Ramp Calibration AVHRR Channel #2 Ramp Calibration AVHRR Channel #3 Ramp Calibration AVHRR Channel #4 Ramp Calibration AVHRR Channel #5 AVHRR Channel #3 Target Temperature AVHRR Channel #4 Target Temperature AVHRR Channel #5 Target Temperature Channel #3 Patch Temperature Spare - undefined See Note 2
Back Scan	30	23 thru 52	10 words of back scan data from each AVHRR Channel 1, 2, 3, 4, & 5. These data are time multiplexed as Channel 3 (word 1), Channel 4 (word 1), Channel 5 (word 1), Channel 3 (word 2), Channel 4 (word 2), Channel 5 (word 2),
Space Data	50	53 thru 102	10 words of space scan data from each AVHRR Channel 3, 4, and 5. These data are time multiplexed as Channel 1 (word 1), Channel 2 (word 1), Channel 3 (word 1), Channel 4 (word 1), Channel 5 (word 1), Channel 1 (word 2), Channel 2 (word 2), Channel 3 (word 2), Channel 4 (word 2), Channel 5 (word 2); etc.
Sync Delta	1	103	Bit 1: 0 = AVHRR Sync Early; 1 = AVHRR Sync Late Bit 2-10: 9 bit binary count of 0.9984 MHz periods; Bit 2 = MSB, Bit 10 = LSB

Table 2-3. GAC Frame Format (2 of 2)

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 9 10 Plus Word Code & Meaning
TIP Data	520	104 thru 623	The 520 words contain 5 minor frames of TIP data (104 TIP data words/frame) Bits 1-8: Exact format as generated by TIP Bit 9: Even parity check over bits 1-8; Bit 10: = Bit 1
AMSU Data	520 Words AMSU Data	624-1143	The 520 words consist of five frames (104 words/frame) of AMSU data from the AIP. Bits 1-8: Exact format as generated by AIP. Bit 9: Even parity check over bits 1-8. Bit 10: Inverted. Bit 1 See Note 3
Spare	39 Words Spare Data	1144-1182	1 0 1 0 0 0 1 1 1 0 1 1 1 0 0 0 1 0 1 1 0 0 0 0 1 0 1 1 1 1 1 1 0 1 0 1 0 0 1 0 thru 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 0 1 0 1 1 0 0 1 0 1 See Note 4
Processed Earth Data	2045	1183 thru 3227	Channel 1 - average sample 1 Channel 2 - average sample 1 Channel 3 - average sample 1 Channel 4 - average sample 1 Channel 5 - average sample 1 Channel 1 - average sample 2 thru Channel 5 - average sample 408 Channel 1 - average sample 409 Channel 2 - average sample 409 Channel 3 - average sample 409 Channel 4 - average sample 409 Channel 5 - average sample 409 See Note 5
Auxiliary Sync	100	3228 thru 3327	1 1 1 1 1 0 0 0 1 0 1 1 1 1 1 1 0 0 1 1 0 1 1 0 1 1 0 1 0 1 1 0 1 0 1 1 1 1 0 1 thru 0 1 1 1 1 1 0 0 0 0 1 1 1 1 0 0 1 1 0 0 See Note 6

NOTES:

- 1) First 60 bits from a 63 bit PN generator started in the all 1's state. The generator polynomial is $X^6 + X^5 + X^2 + X + 1$.
- 2) Each of these words is a 5 channel subcom: 4 words of IR data plus subcom sync (ten 0's).

- 3) The 104th word of each AMSU data frame to the MIRP contains 1110110100.
- 4) Derived by inverting the output of a 1,023 Bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10} + X^5 + X^2 + X + 1$. The generator is started in the all 1's state at the beginning of word 7 of each minor frame.
- 5) Each GAC frame contains processed data which is obtained from every third earth scan of the AVHRR sensor. Each "ave sample" is the average of 4 contiguous samples obtained during each 5 sample interval for each AVHRR sensor channel. The "ave samples" are timed multiplexed as indicated.
- 6) Derived from the non-inverted output of a 1023 Bit PN sequence provided by a feedback shift register generating the polynomial: $X^{10} + X^5 + X^2 + X + 1$. The generator is started in the all 1's state at the beginning of word 3,228.

2.4.2 MIRP HRPT/LAC Formats

The MIRP outputs the High Resolution Picture Transmission (HRPT) format and the Local Area Coverage (LAC) format simultaneously with the Global Area Coverage (GAC) and the Automatic Picture Taking (APT) formats.

The HRPT/LAC format is a serial PCM bit stream, 10 bit words, Most Significant Bit (MSB) first. The bit rate is 665,400 b/s, word rate is 66,540 w/s. A minor frame length is 1/6 of a second, and consists of 11,090 words. A major frame length consists of three minor frames. Figure 2-6 shows the HRPT/LAC frame format and Table 2-4 describes the telemetry in tabular form.

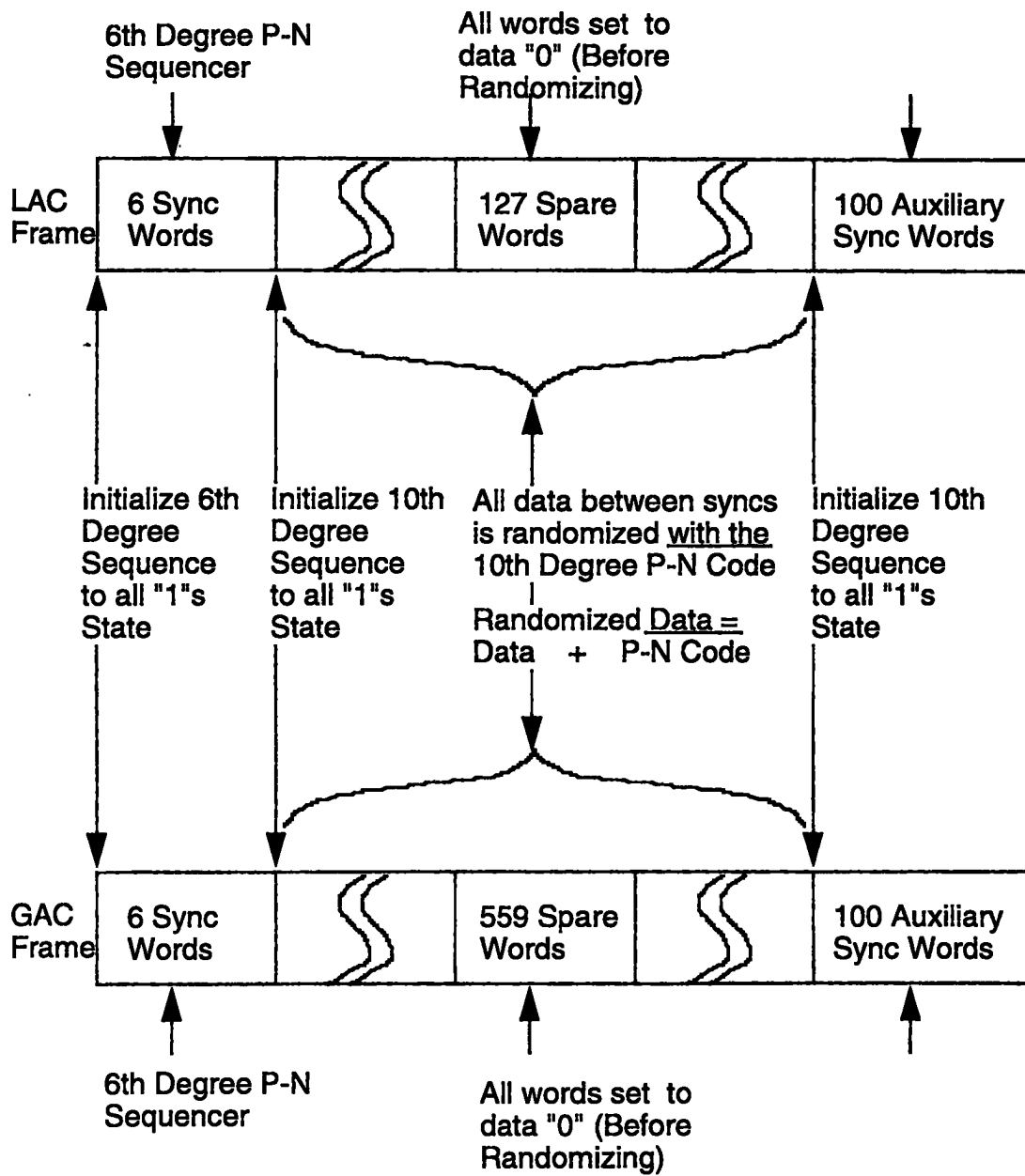


Figure 2-5 Method of Randomizing for LAC/GAC Data

Sync	ID	Time Code	Telemetry Data	Back Scan Data	Space Data	Sync Delta	520 Data Words	Spare	AVHRR Video Data	Aux Sync
6 Wds	2 Wds	4 Wds	10 Words	30 Words	50 Words	1 Word	TIP Data-1st MF Spare Data-2nd MF AMSU Data-3rd MF	127 Words	10,240 Words	100 Words

See Note 2

See Note 6
See Note 7

NOTES:

- 1) Minor Frame (MF) Length - 11,090 words
- 2) Three Minor Frames per Major Frame

First contains TIP data
Second contains spare data
Third contains AMSU data

- 3) Minor Frame Rate - 6 frames per second
- 4) Word Length - 10 bits per word
- 5) Where bit contents of LAC words are specified (as in Note 7), the specification applies prior to data randomizing
- 6) HRPT Output - All spares are 10th degree P-N code (BAR)
- 7) LAC Output - All spares are data '0'

Telemetry Word Allocation		ID Word Bit Allocations	
		1st ID Word	2nd ID Word
1-5	Ramp Calibration	1 Sync ID	(Spare)
6	Ch. 3B Target Temp (5 pt Subcom)	2-3 Frame ID	1-10 All data undefined
7	Ch. 4 Target Temp (5 pt Subcom)	4-7 S/C Address	
8	Ch. 5 Target Temp (5 pt Subcom)	8 Resync Marker	
9	Ch. 3 Patch Temp	9 Input Code from AVHRR/PN	
10	Spare (Undefined)	10 Data '1'	

Figure 2-6. HRPT/LAC Frame Format

Table 2-4. HRPT Minor Frame Format (1 of 3)

Function	No. of Words	Word Position	Bit No.	Plus Word Code & Meaning						
			1 2 3 4 5 6 7 8 9 10							
Frame Sync	6	1	1 0 1 0 0 0 0 1 0 0	See Note 1						
		2	0 1 0 1 1 0 1 1 1 1							
		3	1 1 0 1 0 1 1 1 0 0							
		4	0 1 1 0 0 1 1 1 0 1							
		5	1 0 0 0 0 0 1 1 1 1							
		6	0 0 1 0 0 1 0 1 0 1							
ID	2	7	Bit 1: 0 = Internal Sync; 1 = AVHRR Sync Bits 2 & 3: 00 = Not an HRPT frame but a GAC frame; 01 = Minor Frame #1; 10 = Minor Frame #2; 11 = Minor Frame #3; Bits 4-7: Spacecraft Addresses; Bit 4 = MSB, Bit 7 = LSB Bit 8: 0 = Frame Stable; Frame Resync occurred Bit 9: 1 = Normal AVHRR input; 0 = PN AVHRR input; Bit 10: 0 = AVHRR CH3A, 1 = AVHRR CH3B Bits 1-10: Spare - undefined							
		8								
Time Code	4	9	Bits 1-9: Binary day count; Bit 1 = MSB; Bit 9 = LSB Bit 10: 0; spare							
		10	Bits 1-3: 101, spare Bits 4-10: Part of Binary msec of day count; Bit 4 = MSB							
		11	Bits 1-10: Part of Binary msec of day count;							
		12	Bits 1-10: Remainder of Binary msec of day count; Bit 10 = LSB							
Telemetry	10	13	Ramp Calibration AVHRR Channel #1							See Note 2
		14	Ramp Calibration AVHRR Channel #2							
		15	Ramp Calibration AVHRR Channel #3							
		16	Ramp Calibration AVHRR Channel #4							
		17	Ramp Calibration AVHRR Channel #5							
		18	AVHRR Channel #3 Target Temperature							
		19	AVHRR Channel #4 Target Temperature							
		20	AVHRR Channel #5 Target Temperature							
		21	Channel #3 Patch Temperature							
		22	Spare - Undefined							
Back Scan	30	23 thru 52	10 words of back scan data from each AVHRR channel 3B, 4, and 5. These data are time multiplexed as channel 3 (word 1), channel 4 (word 1), channel 5 (word 1), channel 3 (word 2), channel 4 (word 2), channel 5 (word 2), etc.							
Space Data	50	53 thru 102	10 words of space scan data from each AVHRR channel 1, 2, 3, 4, and 5. These data are time multiplexed as channel 1 (word 1), channel 2 (word 1), channel 3 (word 1), channel 4 (word 1), channel 5 (word 1), channel 1 (word 2), channel 2 (word 2), channel 3 (word 2), channel 4 (word 2), channel 5 (word 2), etc.							
Sync Delta	1	103	Bit 1: 0 = AVHRR sync early; 1 = AVHRR sync late Bits 2-10: 9 bit binary count of 0.9984 MHz periods; Bit 2 = MSB. Bit 10 = LSB							

Table 2-4. HRPT Minor Frame Format (2 of 3)

Function	No. of Words	Word Position	Bit No. 1 2 3 4 5 6 7 8 9 10	Plus Word Code & Meaning								
Data Words	520	104 thru 623	Three sets of data corresponding to three HRPT minor frames per HRPT major frame. First HRPT minor frame: The 520 words contain five TIP minor frames of TIP data (104 TIP data words per TIP minor frame) Bits 1 - 8: Exact format as generated by TIP. Bit 9: Even parity check over Bits 1 - 8. Bit 10: Inverted Bit 1. Second HRPT minor frame: The 520 words consist of five frames (104 words per frame) of spare data in the same form as spare words 624 - 750. Third HRPT minor frame: The 520 words consist of five frames (104 words per frame) of AMSU data from the AIP. Bits 1 - 8: Exact format as generated by AIP. Bit 9: Even parity check over Bits 1 - 8. Bit 10: Inverted Bit 1. See Note 3									
Spare Words	127	624 625 626 627 628 748 749 750	1 0 1 0 0 0 1 1 1 0 1 1 1 0 0 0 1 0 1 1 0 0 0 0 1 0 1 1 1 1 1 0 1 1 0 0 0 1 1 1 1 1 0 1 0 1 0 0 1 0 1 0 0 1 0 1 1 0 1 0 1 1 0 0 1 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 See Note 4									
Earth Data	10,240	751 752 753 754 755 756 10,985 10,986 10,987 10,988 10,989 10,990	Channel 1 - Sample 1 Channel 2 - Sample 1 Channel 3 - Sample 1 Channel 4 - Sample 1 Channel 5 - Sample 1 Channel 1 - Sample 2 Channel 5 - Sample 2047 Channel 1 - Sample 2048 Channel 2 - Sample 2048 Channel 3 - Sample 2048 Channel 4 - Sample 2048 Channel 5 - Sample 2048 See Note 5									

Table 2-4. HRPT Minor Frame Format (3 of 3)

Function	No. of Words	Word Position	Bit No.										Plus Word Code & Meaning
			1	2	3	4	5	6	7	8	9	10	
Auxiliary Sync	100	10,991	1	1	1	1	1	0	0	0	1	0	See Note 6
		10,992	1	1	1	1	1	1	0	0	1	1	
		10,993	0	1	1	0	1	1	0	1	0	1	
		10,994	1	0	1	0	1	1	1	1	0	1	
		11,089	0	1	1	1	1	1	0	0	0	0	
		11,090	1	1	1	1	0	0	1	1	0	0	

Notes:

- 1) First 60 bits from a 63 bit PN generator in the all '1's state
The generator polynomial is $X^6 + X^5 + X^2 + X + 1$
- 2) Each of these words is a five channel subcom; four words of IR data plus subcom sync (10 '0's)
- 3) The 104th word of each AMSU data frame to the MIRP contains 1110110100
- 4) Derived by inverting the output of a 1,023 bit PN sequence provided by a feedback shift register generating the polynomial:
 $X^{10} + X^5 + X^2 + X + 1$
The generator is started in the all 1's state at the beginning of word 7 of each minor frame.
- 5) Each minor contains the data obtained during one Earth scan of the AVHRR sensor. The data from the five sensor channels of the AVHRR are time multiplexed as indicated.
- 6) Derived from the non-inverted the output of a 1,023 bit PN sequence provided by a feedback shift register generating the polynomial:
 $X^{10} + X^5 + X^2 + X + 1$
The generator is started in the all 1's state at the beginning of word 10,991

2.4.3 MIRP Automatic Picture Transmission (APT) Format (All MIRP Modes Except MIRP Input Data Substitute Mode)

The MIRP outputs the APT format simultaneously with the HRPT, LAC, and GAC formats. The APT format conforms to Table 2-5, Figure 2-7, Figure 2-8, and the following subparagraphs.

2.4.3.1 APT Signal Analog Characteristics

The APT signal has the following analog characteristics:

- a. Carrier Frequency - 2.4 kHz.
- b. Modulation operating range: constant maximum numerical input (=255) to the Digital-to-Analog Converter (DAC) produces constant maximum carrier amplitude. The maximum amplitude is specified in PS-228491. Constant numerical input (=0) to the DAC produces constant 0.07 +/-0.03 of maximum subcarrier amplitude.
- c. Linearity: Subcarrier amplitude is proportional to the numerical input to the DAC +/-2% of maximum subcarrier amplitude over the operating range defined in (b).
- d. Filtering: The APT signal passes through a low pass filter before amplitude modulation and another low-pass filter after amplitude modulation. The pre-modulation filter is a third order low pass transitional Butterworth Thomson filter with 2400 Hz 3-dB bandwidth. The post-modulation filter is a three-pole Butterworth Thomson low-pass filter with 6000 Hz 3-dB bandwidth.
- e. Spurious outputs are more than 40-dB below the subcarrier in the band 400 Hz to 4400 Hz when the modulating signal occupies the full operating range in (b).
- f. Coherent noise is imperceptible on a test APT display when the AVHRR is shut off.

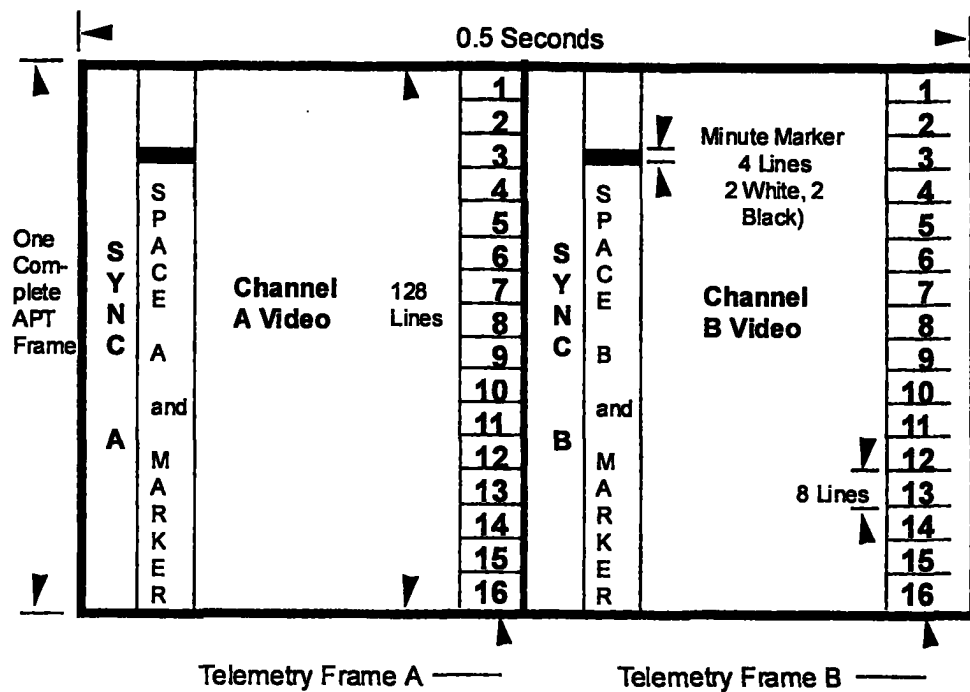
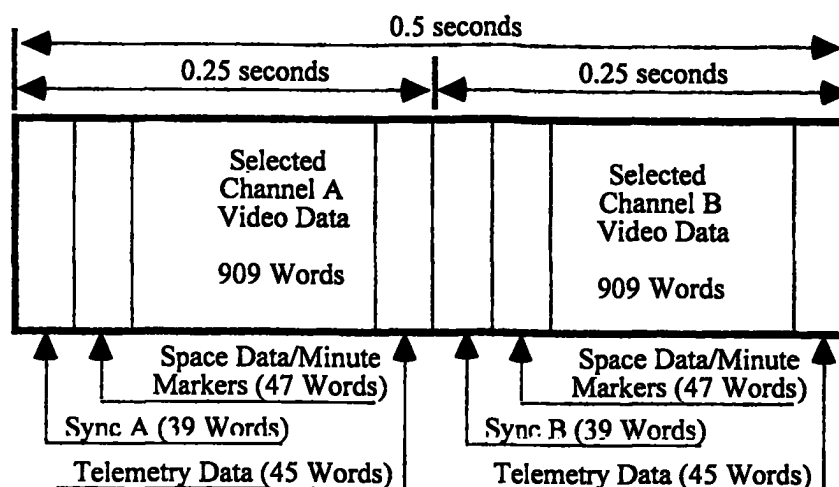


Figure 2-7 APT Frame Format



NOTES:

- 1) Equivalent Output Digital Data Rate is 4160 Words/Second
- 2) Video Line Rate - 2 Lines/Second
- 3) APT Frame Size - 128 Lines
- 4) Any two of the five (six for group 506) AVHRR channels may be selected for use
- 5) Sync A is a 1040-Hz square wave - 7 Cycles
- 6) Sync B is an 832-pulses per second (pps) pulse train - 7 pulses
- 7) Each of the 16 telemetry points are repeated on 8 successive lines
- 8) Minute markers are repeated on 4 successive lines, with 2 lines Black and 2 lines White

Figure 2-8. APT Video Line Format (Prior to D/A Converter)

2.4.3.2 APT Video Line Structure

Each line of APT output video data contains 2080 analog video elements. Each element is present in the video line for a period of one APT word duration as defined in Table 2-5. Each element (except Sync A and Sync B) is proportional to the result of a D/A conversion of the eight most significant bits of a 10-bit digital word.

- Sync A
- Space A with Minute Markers
- Channel A Video
- Telemetry A (16 point subcom)
- Sync B
- Space B with Minute Markers
- Channel B Video
- Telemetry B (16 point subcom)

2.4.3.3 APT Sync Format

Every line of APT video data contains two sync intervals, designated as Sync A and Sync B.

Sync A precedes the Space data A interval and is equal to 39 APT words, nominally 9.375 milliseconds in duration. It contains seven cycles of a square wave with frequency $1/4$ the APT word rate, nominally 1040 Hz.

Sync B is at the midpoint of each video line and precedes the Space data B interval. It lasts for a period equal to 39 APT words, nominally 9.375 milliseconds and contains seven pulses of a pulse train with frequency $1/5$ the APT word rate, nominally 832 pulses per second (PPS). Sync B pulses have a 3:2 symmetry ratio, as shown in Figure 2-9.

2.4.3.4 APT Space Data and Minute Markers

Immediately following Sync A and Sync B, each APT video line contains Space Data which is periodically overwritten by a time reference marker occurring at a one-minute repetition rate. Each Space data interval immediately precedes the channel video information and is equal to 47 APT words, nominally 11.298 milliseconds in duration.

The space data in each interval is derived from the same AVHRR channel whose data is presented in the following video interval.

Table 2-5. APT Format Parameters - All MIRP Modes Except MIRP Input Data

Form of Data	Analog video signal, amplitude modulating a 2400 Hz subcarrier
Line Length	1/2 second
Frame Length	128 lines, 64 seconds
Word Rate	4160 w/s
Word Length	8 bit } Prior to D-to-A conversion
Video Bandwidth	2.4 kHz

Minute marker data is inserted into the Space Data interval every minute and overrides the existing Space Data. Minute markers are repeated on four consecutive video lines for every occurrence of the marker and are composed of two lines of maximum modulation and two lines of minimum modulation.

2.4.3.5 Processing of APT Earth Data

The data contained in the two earth data portions of the APT lines is each derived by processing a single channel of AVHRR input data. The processing of the data varies as a function of its position within the AVHRR scan line, and is performed to accomplish bandwidth reduction and geometric correction. All processing is performed in the digital domain.

The data processing algorithm is based upon averaging every third scan line of AVHRR data. The averaging process with each line applies to a single AVHRR channel, and is divided into five specific regions relative to earth nadir. The algorithm is as follows:

In Region 1 - (nominally $\pm 16.98^\circ$ on either side of nadir) - Average each contiguous group of four samples from the selected channel.

In Region 2 - (nominally -34.83° to -16.98° to and $+16.98^\circ$ to $+34.83^\circ$) - Average each contiguous group of two samples, skip one sample and repeat.

In Region 3 - (nominally -43.83° to -34.83° and $+34.83^\circ$ to $+43.81^\circ$) - Average each contiguous group of two samples.

In Region 4 - (nominally -48.84° to -43.81° and $+43.81^\circ$ to $+48.84^\circ$) - Consider a contiguous group of three samples A, B, C. Derive two output values:

$$\frac{A + B}{2} \quad \text{and} \quad \frac{B + C}{2}$$

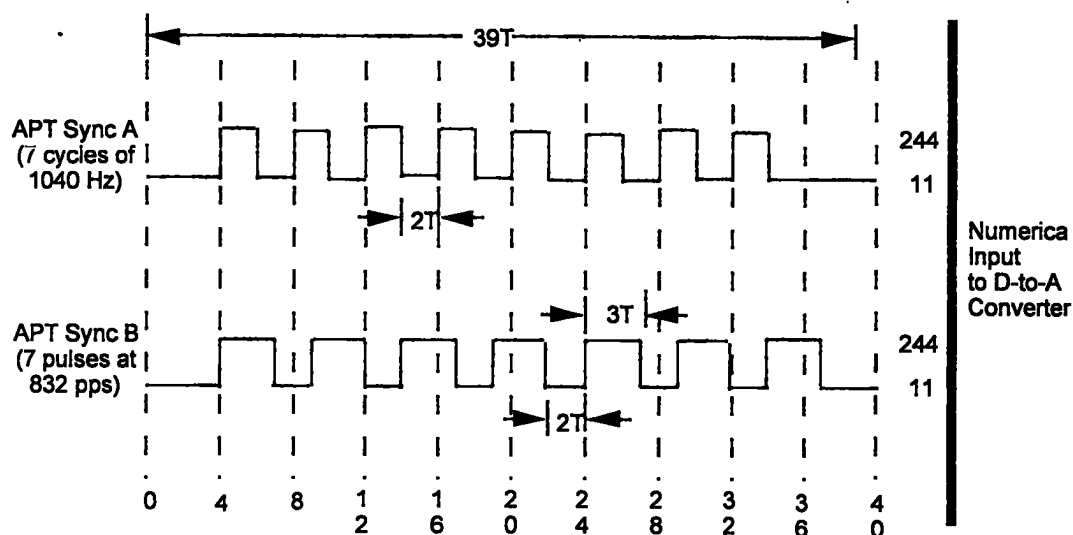
In Region 5 - (nominally -55.38° to -48.84° and $+48.84^\circ$ to $+55.38^\circ$) - Consider a contiguous group unmodified.

Two successive AVHRR scan lines are used to obtain the earth data for each APT line. One AVHRR scan line is used for Channel A and the next scan line for Channel B.

The APT earth data processing regions are defined in terms of internal MIRP timing in Table 2-6.

2.4.3.6 APT Telemetry Data Frames

The MIRP provides telemetry data in two separate intervals within each APT video line. The two intervals each is 10.817 milliseconds in duration. Each telemetry point is repeated in each of eight successive APT video lines.



Notes:

- 1) $T = 1/4160$ second.
- 2) Sync A precedes Channel A data
- 3) Sync B precedes Channel B data

Figure 2-9. APT Sync Details

Table 2-6. APT Earth Data Processing Regions

APT Data Processing Region		Times of Data Samples Pulses (Clock Counts)		Number of AVHRR Data Samples Collected Per Channel	Number of Processed APT Words Output to D to A Converter Per Selected Channel
Region Number	Before/After Nominal/Nadir	First Pulse	Last Pulse		
5	Before	8,600	11,600	121	121
4	Before	11,625	13,925	93	62
3	Before	13,950	18,075	166	83
2	Before	18,100	26,325	330	110
1	Before	26,350	42,025	628	157
2	Before	42,050	50,275	330	110
3	After	50,300	54,425	166	83
4	After	54,450	56,750	93	62
5	After	56,776	59,775	121	121

Notes: 1) 'Clock Counts' are counts of the 0.09984 MHz clock after the leading edge of a AVHRR line sync (or internal sync in internal sync mode).

2) Nominal nadir is at 34,200 counts.

One complete APT telemetry frame is provided in each APT frame. Each telemetry frame consists of 16 individual telemetry points as shown in Figure 2-10.

The telemetry points are formatted as detailed below:

Telemetry Point # 1	-	Grey Scale Wedge #1
Telemetry Point # 2	-	Grey Scale Wedge #2
Telemetry Point # 3	-	Grey Scale Wedge #3
Telemetry Point # 4	-	Grey Scale Wedge #4
Telemetry Point # 5	-	Grey Scale Wedge #5
Telemetry Point # 6	-	Grey Scale Wedge #6
Telemetry Point # 7	-	Grey Scale Wedge #7
Telemetry Point # 8	-	Grey Scale Wedge #8
Telemetry Point # 9	-	Zero Modulation Reference
Telemetry Point # 10 - #13	-	Thermistor Temperature
Telemetry Point # 14	-	Patch Temperature *
Telemetry Point # 15	-	Back Scan
Telemetry Point # 16	-	Channel I.D. Wedge

*Will toggle when channel 3A selected

2.4.3.6.1 Telemetry Points #1 through #9

Each of the first nine telemetry points in the APT telemetry frame consists of an individual step from a grey scale internally generated in the MIRP. The numerical input to the D to A converter is a fixed value during each step as defined in Table 2-8. The corresponding subcarrier amplitude is fixed values as defined in Table 2-8 to within the linearity specification in paragraph 2.5.1.

2.4.3.6.2 IR Target Temperature

Telemetry points #10 - #13 within the APT telemetry frame is used to indicate the IR target temperatures of the AVHRR. Data for these points is obtained from channels #3, #4, #5, selectable by command, when sampled during the IR target temperature time specified in Table 2-7. Data for these telemetry points is the same for both APT telemetry frames, Telemetry A and Telemetry B.

Data for these four telemetry points is obtained from five contiguous AVHRR scans during the IR target temperature samples intervals defined in Table 2-7. Designate as scan m the AVHRR scan from which the APT Channel A earth data at the start of the APT telemetry frame was taken. Then the five contiguous scans are $(m + 188)$ through $(m + 192)$.

2.4.3.6.3 Patch Temperature

Telemetry point #14 within the APT telemetry frame is used to indicate AVHRR patch temperature. Data for this point is obtained from channels #3, #4, or #5, selectable by command, when sampled during the patch temperature time specified in Table 2-7. Data for this point is the same in both APT telemetry frames, Telemetry A and Telemetry B.

The patch temperature telemetry will toggle between valid temperature telemetry and a reference value when channel 3A (1.6 microns) is selected.

Table 2-7 MIRP Data Sample Times

Data	Sample Pulse Time in periods of 39,936 Hz following AVHRR line sync (or internal sync in internal Sync Mode)		No. of Sample Pulses
	First Pulse	Last Pulse	Generated
Space Data	101	110	10
Ramp Calibration	150	150	1
Earth Data	344	2391	2048
Target Temper- ature	2627	2627	1
Patch Temper- ature	2636	2636	1
Back Scan	4715	4724	10

When the MIRP is in Input Data Substitution Mode, it makes the internal data substitution. The MIRP uses the P-N code instead of AVHRR data in its processing and formatting.

Table 2-8 APT Grey Scale Parameters

Telemetry Point	Numerical Input to D to A Converter	Subcarrier Amplitude
1	31	Minimum plus 31/255 of operating range per 2.5.1
2	63	Minimum plus 63/255 of operating range per 2.5.1
3	95	Minimum plus 95/255 of operating range per 2.5.1
4	127	Minimum plus 127/255 of operating range per 2.5.1
5	159	Minimum plus 159/255 of operating range per 2.5.1
6	191	Minimum plus 191/255 of operating range per 2.5.1
7	223	Minimum plus 223/255 of operating range per 2.5.1
8	255	Maximum per 2.5.1
9	0	Maximum per 2.5.1

Back scan data in telemetry frame A is obtained from the same AVHRR channel which is used in the Channel A portion of the APT video line. Back scan data in Telemetry frame B is obtained from the same AVHRR channel which is used in the Channel B portion of the APT video line.

2.4.3.6.5 Channel Identification Wedge

The sixteenth telemetry point in the APT telemetry frame (Figure 2-10) is used for channel identification. Telemetry A identifies the channel data which is being provided during the Channel A portion of the video line. Telemetry B identifies the channel data which is being provided during the Channel B portion of each video line.

Channel identification is implemented by inserting in this telemetry point a DC level, which results in a modulation index equal to one of the first six grey scale levels. Channel 3B corresponds to Wedge #3 and Channel 3A corresponds to Wedge #6. All other channel numbers are the same as the number of the corresponding grey scale wedge.

One Complete Telemetry Frame

	Wedge #1	Wedge #2	Wedge #3	Wedge #4	Wedge #5	Wedge #6	Wedge #7	Wedge #8
1	2	3	4	5	6	7	8	
Zero Modulation Reference	Therm. Temp. #1	Therm. Temp. #2	Therm. Temp. #3	Therm. Temp. #4	Patch Temp. #1	Back Scan	Channel I.D. Wedge	
9	10	11	12	13	14*	15	16	

- Notes:
- 1) Each telemetry frame consists of 10 points.
 - 2) Telemetry frame rate is one frame per 64 seconds.
 - 3) Each telemetry point is repeated on 8 successive APT video lines.

*toggles when 3A used

Figure 2-10. APT 16 Point Telemetry Frame

Section 3

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Section 3. NOAA-K, -L, -M Instrument Telemetry Data Parameters

This section consists of a series/group of data packages, one for each instrument, and each contains the same type of information. A detailed description of the instruments data signals (Digital A Telemetry, Digital B Telemetry and Analog Telemetry, telemetry formats and associated circuitry).

Contained below is a listing of the instrument data packages.

- a. Paragraph 3.1: Advanced Microwave Sounder Unit (AMSU-A1).
- b. Paragraph 3.2: AMSU-A2.
- c. Paragraph 3.3: AMSU-B.
- d. Paragraph 3.4: Advanced Very High Resolution Radiometer (AVHRR/3).
- e. Paragraph 3.5: Data Collection System (DCS-2).
- f. Paragraph 3.6: High Resolution Infrared Radiation Sounder (HIRS/3).
- g. Paragraph 3.7: Search and Rescue Processor (SARP-2).
- h. Paragraph 3.8 Search and Rescue Repeater (SARR).
- i. Paragraph 3.9: Solar Backscatter Ultraviolet Radiometer (SBUV/2).
- j. Paragraph 3.10: Space Environment Monitor (SEM-2).

3.1 Advanced Microwave Sounder Unit (AMSU-A1)

3.1.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft are assignable into three categories, instrument Digital A (Scientific) Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the AMSU-A1 are as detailed below:

3.1.2 Digital A Data

Digital A data is clocked into the spacecraft AMSU Information Processor (AIP) at a 16.64

kb/sec rate by the shift pulse (C_1) whenever the Data Enable Pulse (A_1) is presented to the instrument. The AMSU-AI data will be in AIP minor frame words 8 through 33. The AIP reads the digital A Data Output from the AMSU-A in 16-bit words.

3.1.2.1 General Requirements

- a. Content: See Table 3-1A through 3-1G
- b. Word Length: 16 bits (two 8-bit bytes)
- c. Serial Output: thirteen 16-bit words per 100 msec.

Table 3-1A. AMSU-A1 Digital A Data Format-Full Scan Mode (1 of 3)

AI Frame Byte No.	Parameter
1 -3	Sync. Sequence (FF Hex)
4	Unit identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Position 1, MSP, First reading
10	Reflector 1, Position 1, LSP, First reading
11	Reflector 2, Position 1, MSP, First reading
12	Reflector 2, Position 1, LSP, First reading
13	Reflector 1, Position 1, MSP, Second reading
14	Reflector 1, Position 1, LSP, Second reading
15	Reflector 2, Position 1, LSP, Second reading
16	Reflector 2, Position 1, LSP, Second reading
17	Scene Position 1, Channel 3, MSP
18	Scene Position 1, Channel 3, LSP
19 - 40	Bytes 17 & 18 are repeated for Channels 4 through 14
41	Scene Position 1, Channel 15, MSP
42	Scene Position 1, Channel 15, LSP
43	Reflector 1, Position 2, MSP, First reading
44	Reflector 1, Position 2, LSP, First reading
45	Reflector 2, Position 2, MSP, First reading
46	Reflector 2, Position 2, LSP, First reading
47	Reflector 1, Position 2, MSP, Second reading
48	Reflector 1, Position 2, LSP, Second reading
49	Reflector 2, Position 2, MSP, Second reading
50	Reflector 2, Position 2, LSP, Second reading
51	Scene Position 2, Channel 3, MSP
52	Scene Position 2, Channel 3, LSP

Table 3-1A. AMSU-A1 Digital A Data Format-Full Scan Mode (2 of 3)

53 - 74	Bytes 51 & 52 are repeated for Channels 4 through 14
75	Scene Position 2, Channel 15, MSP
76	Scene Position 2, Channel 15, LSP
77	Reflector 1, Position 3, MSP, First reading
78	Reflector 1, Position 3, LSP, First reading
79	Reflector 2, Position 3, MSP, First reading
80	Reflector 2, Position 3, LSP, First reading
81	Reflector 1, Position 3, MSP, Second reading
82	Reflector 1, Position 3, LSP, Second reading
83	Reflector 2, Position 3, MSP, Second reading
84	Reflector 2, Position 3, LSP, Second reading
85	Scene Position 3, Channel 3, MSP
86	Scene Position 3, Channel 3, LSP
87 - 110	Bytes 85 & 86 are repeated for Channel 4 through 15
111 - 1028	Bytes 77 - 110 are repeated for Positions 4 through 30
1029	Reflector 1, Cold Cal. Position, MSP, First reading
1030	Reflector 1, Cold Cal. Position, LSP, First reading
1031	Reflector 2, Cold Cal. Position, MSP, First reading
1032	Reflector 2, Cold Cal. Position, LSP, First reading
1033	Reflector 1, Cold Cal. Position, MSP, Second reading
1034	Reflector 1, Cold Cal. Position, LSP, Second reading
1035	Reflector 2, Cold Cal. Position, MSP, Second reading
1036	Reflector 2, Cold Cal. Position, LSP, Second reading
1037	Cold Calibration 1, Channel 3, MSP
1038	Cold Calibration 1, Channel 3, LSP
1039 - 1062	Bytes 1038 & 1039 are repeated for Channel 4 through 15
1063	Cold Calibration 2, Channel 3, MSP
1064	Cold Calibration 2, Channel 3, LSP
1065 - 1088	1063 & 1064 are repeated for Channel 4 through 15
1089	Temp Sensor 1, MSP
1090	Temp Sensor 1, LSP
1091	Temp Sensor 2, MSP
1092	Temp Sensor 2, LSP
1093 - 1178	Bytes 1091 & 1092 are repeated for Sensors 3 through 45

Table 3-1A. AMSU-A1 Digital A Data Format-Full Scan Mode (3 of 3)

1179	Temp Sensor Reference Voltage, MSP
1180	Temp Sensor Reference Voltage, LSP
1181	Reflector 1 Warm Cal. Position, MSP, First reading
1182	Reflector 1 Warm Cal. Position, LSP, First reading
1183	Reflector 2 Warm Cal. Position, MSP, First reading
1184	Reflector 2 Warm Cal. Position, LSP, First reading
1185	Reflector 1 Warm Cal. Position, MSP, Second reading
1186	Reflector 1 Warm Cal. Position, LSP, Second reading
1187	Reflector 2 Warm Cal. Position, MSP, Second reading
1188	Reflector 2 Warm Cal. Position, LSP, Second reading
1189	Warm Calibration 1, Channel 3, MSP
1190	Warm Calibration 1, Channel 3, LSP
1191-1214	Bytes 1189 & 1190 are repeated for Channels 4 through 15
1215	Warm Calibration 2, Channel 3, MSP
1216	Warm Calibration 2, Channel 3, LSP
1217-1240	Bytes 1215 & 1216 are repeated for Channels 4 through 15
1241-1243	Sync. Sequence (FF Hex)
1244	Unit Identification and Serial Number
NOTE	
1.	In the above table the MSP is the most significant portion of a particular measurement while the LSP is the least significant portion of the particular measurement.
2.	In the above table the first set of readings for a particular reflector position are made prior to the integration interval, while the second set of readings are made approximately 1/2 way through the integration period.
3.	Digital A data as read by the spacecraft shall contain an undetermined number of "fill words". These fill words are 0001H and will be intermingled with valid data. The Digital A data as sent by the instrument is such that no valid data of 0001H is included.
4.	Format of Position data is: DDDDDDDDDDDDDDE0 D = Data E = Error bit, 0 = not in spec, 1 = spec. 0 = Zero
5.	Format of Radiometer data is: DDDDDDDDDDDDDDD0 D = Data 0 = Zero
6.	Temperature Sensor Reference Voltage utilized for temperature sensors 36-45 only.

3.1.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcoms generated by the TIP shall sample each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Section 3.1.6, 3.1.8.2, and 3.1.8.3 of the General Instrument Interface Specification (IS-3267415).

Words 8 and 12 of the TIP Minor Frame (AIP Minor Frame Words 111 and 115) will be dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.1.3.1 Digital B Telemetry Points

Twelve Digital B Telemetry Points are required by the AMSU-A1. The Digital B Telemetry Points provided are as shown in Table 3-1F.

3.1.4 Analog Telemetry

The Analog Telemetry needed when instrument power is off is available at the instrument interface at all times.

Three different subcoms types (32, 16 and 1 second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GIIIS. AMSU-A1 shall use the 16-second Analog subcoms.

3.1.4.1 Analog Telemetry Points

Analog Telemetry Points used by the AMSU-A1 are as shown in Table 3-1G. Descriptions of each telemetry point are detailed below.

The AMSU-A1 is provided twenty-seven analog telemetry channels to monitor the health of the instrument.

3.1.4.2 Exceptions

The instrument output signals conform to Sections 3.1.6 and 3.1.8 of the GIIIS. The exceptions to the above specification are as follows:

None

Table 3-1B. AMSU-A1 Digital A Data Format-Warm Cal Mode

A1 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Warm Cal. Position, MSP, First reading
10	Reflector 1, Warm Cal. Position, LSP, First reading
11	Reflector 2, Warm Cal. Position, MSP, First reading
12	Reflector 2, Warm Cal. Position, LSP, First reading
13	Reflector 1, Warm Cal. Position, MSP, Second reading
14	Reflector 1, Warm Cal. Position, LSP, Second reading
15	Reflector 2, Warm Cal. Position, MSP, Second reading
16	Reflector 2, Warm Cal. Position, LSP, Second reading
17	Warm Cal. Position, Channel 3, MSP
18	Warm Cal. Position, Channel 3, LSP
19	Warm Cal. Position, Channel 4, MSP
20	Warm Cal. Position, Channel 4, LSP
21-40	Bytes 19 & 20 are repeated for Channels 5 through 14
41	Warm Cal. Position, Channel 15, MSP
42	Warm Cal. Position, Channel 15, LSP
43-1028	Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.
1029	Temp Sensor 1, MSP
1030	Temp Sensor 1, LSP
1031-1116	Bytes 1029 & 1030 are repeated for Temp Sensors 2 through 44
1117	Temp Sensor 45, MSP
1118	Temp Sensor 45, LSP
1119	Temp Sensor Reference Voltage, MSP
1120	Temp Sensor Reference Voltage, LSP
Refer to the note from Table 3-1A.	

Table 3-1C. AMSU-A1 Digital A Data Format-Cold Cal Mode

A1 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Cold Cal. Position, MSP, First reading
10	Reflector 1, Cold Cal. Position, LSP, First reading
11	Reflector 2, Cold Cal. Position, MSP, First reading
12	Reflector 2, Cold Cal. Position, LSP, First reading
13	Reflector 1, Cold Cal. Position, MSP, Second reading
14	Reflector 1, Cold Cal. Position, LSP, Second reading
15	Reflector 2, Cold Cal. Position, MSP, Second reading
16	Reflector 2, Cold Cal. Position, LSP, Second reading
17	Cold Cal. Position, Channel 3, MSP
18	Cold Cal. Position, Channel 3, LSP
19	Cold Cal. Position, Channel 4, MSP
20	Cold Cal. Position, Channel 4, LSP
21-40	Bytes 19 through 20 are repeated for Channels 5 through 14.
41	Cold Cal. Position, Channel 15, MSP
42	Cold Cal. Position, Channel 15, LSP
43-1028	Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.
1029	Temp Sensor 1, MSP
1030	Temp Sensor 1, LSP
1031	Temp Sensor 2, MSP
1032	Temp Sensor 2, LSP
1033-1116	Bytes 1031 & 1032 are repeated for Sensors 3 through 44.
1117	Temp Sensor 45, MSP
1118	Temp Sensor 45, LSP
1119	Temp Sensor Reference Voltage, MSP
1120	Temp Sensor Reference Voltage, LSP
Refer to the note from Table 3-1A.	

Table 3-1D. AMSU-A1 Digital A Data Format-Nadir Mode

AI Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector 1, Position 15, MSP, First reading
10	Reflector 1, Position 15, LSP, First reading
11	Reflector 2, Position 15, MSP, First reading
12	Reflector 2, Position 15, LSP, First reading
13	Reflector 1, Position 15, MSP, Second reading
14	Reflector 1, Position 15, LSP, Second reading
15	Reflector 2, Position 15, MSP, Second reading
16	Reflector 2, Position 15, LSP, Second reading
17	Nadir Position, Channel 3, MSP
18	Nadir Position, Channel 3, LSP
19	Nadir Position, Channel 4, MSP
20	Nadir Position, Channel 4, LSP
21-40	Bytes 19 and 20 are repeated for channels 5 through 14
41	Nadir Position, Channel 15, MSP
42	Nadir Position, Channel 15, LSP
43-1028	Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.
1029	Temp Sensor 1, MSP
1030	Temp Sensor 1, LSP
1031	Temp Sensor 2, MSP
1032	Temp Sensor 2, LSP
1033-1116	Bytes 1031 & 1032 are repeated for Sensors 3 through 44.
1117	Temp Sensor 45, MSP
1118	Temp Sensor 45, LSP
1119	Temp Sensor Reference Voltage, MSP
1120	Temp Sensor Reference Voltage, LSP
Refer to the note from Table 3-1A.	

Table 3-1E. AMSU-A1 Data Word Description (1 of 3)

Bit	Description
Digital Housekeeping Data, Byte Number 1	
0	0.
1	Full Scan Mode: 0 = Not Full Scan, 1 = Full Scan
2	Warm Cal Mode: 0 = Not in Warm Cal, 1 = Warm Cal
3	Cold Cal Mode: 0 = Not in Cold Cal, 1 = Cold Cal
4	Nadir Mode: 0 = Not in Nadir, 1 = Nadir
5	Cold Cal Position, LSB
6	Cold Cal Position, MSB
7	0.
Digital Housekeeping Data, Byte Number 2	
0	0.
1	Scanner A1-1 Power: 0 = Off, 1 = On.
2	Scanner A1-2 Power: 0 = Off, 1 = On.
3	PLL Power: 0 = Redundant, 1 = Primary.
4	Survival Heater Power: 0 = Off, 1 = On.
5	0.
6	0.
7	0.
Digital Housekeeping Data, Byte Number 3	
0	0.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.
Digital Housekeeping Data, Byte Number 4	
0	0.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.

Table 3-1E. AMSU-A1Data Word Description (2 of 3)

Number	Location
AMSU, AI Temp Sensor Assignments	
1	Scan Motor A1-1
2	Scan Motor A1-2
3	Feed Horn A1-1
4	Feed Horn A1-2
5	RF Mux A1-1
6	RF Mux A1-2
7	Local Oscillator Channel 3
8	Local Oscillator Channel 4
9	Local Oscillator Channel 5
10	Local Oscillator Channel 6
11	Local Oscillator Channel 7
12	Local Oscillator Channel 8
13	Local Oscillator Channel 15
14	PLL LO #2 Channels 9 through 14
15	PLL LO #1 Channels 9 through 14
16	PLL LO (Reference Oscillator)
17	Mixer/IF Amplifier Channel 3
18	Mixer/IF Amplifier Channel 4
19	Mixer/IF Amplifier Channel 5
20	Mixer/IF Amplifier Channel 6
21	Mixer/IF Amplifier Channel 7
22	Mixer/IF Amplifier Channel 8
23	Mixer/IF Amplifier Channel 9/14
24	Mixer/IF Amplifier Channel 15
25	IF Amplifier Channel 11/14

Table 3-1E. AMSU-A1 Data Word Description (3 of 3)

Bit	Description
26	IF Amplifier Channel 9
27	IF Amplifier Channel 10
28	IF Amplifier Channel 11
29	DC/DC Converter
30	IF Amplifier Channel 13
31	IF Amplifier Channel 14
32	IF Amplifier Channel 12
33	RF Shelf A1-1
34	RF Shelf A1-2
35	Detector/Preamplifier Assembly
36	A1-1 Warm load 1 *
37	A1-1 Warm load 2
38	A1-1 Warm load 3
39	A1-1 Warm load 4
40	A1-1 Warm load center
41	A1-2 Warm load 1
42	A1-2 Warm load 2
43	A1-2 Warm load 3
44	A1-2 Warm load 4
45	A1-2 Warm load center
AMSU-A1 Data Identification Words	
Unit No.	Identification No. (Binary)
Engineering Model Module A-1	00000001
Proto Flight Model Module A-1	00000101
Flight Model I Module A-1	00001001
Flight Model 2 Module A-1	00001101

*Not functional on NOAA-K

Table 3-1F. AMSU-A1 Digital B Telemetry

No.	Telemetry Point Name	*Logic "1"	Logic "0"	Ch #
1	Scanner A1-1 Power ON/OFF**	ON	OFF	56
2	Scanner A1-2 Power ON/OFF**	ON	OFF	88
3	Phase Lock Loop	PRIMARY	REDUNDANT	120
4	Antenna in Warm Cal Position	YES	NO	152
5	Antenna in Cold Cal Position	YES	NO	184
6	Antenna in Nadir Position	YES	NO	216
7	Full Scan	YES	NO	248
8	Survival Heater ON/OFF**	ON	OFF	25
9	Module Power**	CONNECT	DISCONNECT	57
10	Cold Cal Position MSB	See Note		89
11	Cold Cal Position LSB			121
12	Spare			153

*Logic "1" is a "Low Voltage" State

**Must correctly indicate power status with instrument power OFF.

NOTE

MSB LSB

0	0	6.667 degrees from -Z
0	1	8.333 degrees from -Z
1	0	9.999 degrees from -Z
1	1	13.332 degrees from -Z

If telemetry points 4, 5, 6 & 7 all indicate Logic "0", the instrument is operating with the antenna in warm cal position.

Table 3-1G. AMSU-A1 Analog Telemetry

No.	Telemetry Point Name	**Range Limits		Ch# (mnf#)
		Red (Low/High)	Yellow (Low/High)	
1	A1-1 Scanner Motor Temperature*	-30°C/58°C	-20°C/66°C	388(4)
2	A1-2 Scanner Motor Temperature*	-30°C/58°C	-20°C/66°C	389(5)
3	RF Shelf A1-1 Temperature*	-30°C/58°C	-20°C/66°C	396(12)
4	RF Shelf A1-2 Temperature*	-30°C/58°C	-20°C/66°C	397(13)
5	Warm Load A1-1 Temperature*	-30°C/58°C	-20°C/66°C	399(15)
6	Warm Load A1-2 Temperature *	-30°C/58°C	-20°C/66°C	403(19)
		Minimum/Low	Maximum/High	
7	Antenna A1-1 Drive Motor Current (Average)	40 mA	107 mA	404(20)
8	Antenna A1-2 Drive Motor Current (Average)	40 mA	107 mA	406(22)
9	+15 VDC (Signal Processing)	14.0 V	16.0 V	407(23)
10	+15 VDC (Antenna Drive)	13.5 V	18.0 V	411(27)
11	-15 VDC (Signal Processing)	-16.0 V	-14.0 V	412(28)
12	-15 VDC (Antenna Drive)	-16.5 V	-13.5 V	415(31)
13	+8 VDC (Receiver Amplifiers)	7.0 V	9.0 V	419(35)
14	+5 VDC (Signal Processing)	4.0 V	6.0 V	420(36)
15	+5 VDC (Antenna Drive)	4.0 V	6.0 V	421(37)
16	+8.5 VDC Phase Lock Loop Ch 9/14	7.5 V	9.5 V	423(39)
17	+15 VDC Phase Lock Loop Ch 9/14	14.0 V	16.0 V	427(43)
18	-15 VDC Phase Lock Loop Ch 9/14	-16.0 V	-14.0 V	428(44)
19	GDO Voltage 50.3 GHz Ch 3	5.0 V	7.0 V	429(45)
20	GDO Voltage 52.8 GHz Ch 4	4.75 V	6.75 V	431(47)
21	GDO Voltage 53.596 GHz Ch 5	4.8 V	6.8 V	435(51)
22	GDO Voltage 54.4 GHz Ch 6	4.4 V	6.4V	436(52)
23	GDO Voltage 54.94 GHz Ch 7	4.5 V	6.5 V	437(53)
24	GDO Voltage 55.5 GHz Ch 8	4.3 V	6.3 V	439(55)
25	PLLO Primary Lock Detect (PLLO #1)	0.0 V	15.0 V	443(59)
26	PLLO Redundant Lock Detect (PLLO #2)	0.0 V	15.0 V	444(60)
27	GDO Voltage 89.0 GHz Ch 15	4.85 V	6.85 V	445(61)
* Powered by the +28V Analog TLM B				
** These limits pertain to AMSU-A1, P/N 1331720, S/N 102, 103, & 104				

3.2 Advanced Microwave Sounder Unit (AMSU-A2)

3.2.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft are assignable into three categories; Digital A (Scientific) Data, Digital B Telemetry and Analog Telemetry. The specific signals supplied by the AMSU-A2 are as detailed below:

3.2.2 Digital A Data

Digital A data is clocked into the spacecraft AIP at a 16.64 kb/sec rate by the shift pulse (C_1) whenever the Data Enable Pulse (A_1) is presented to the instrument. The AMSU-A2 data will be in AIP minor frame words 34 through 47.

3.2.2.1 General Requirements

- a. Content: See Tables 3-2A through 3-2G
- b. Word Length: 16 bits (two 8 bit bytes)
- c. Serial Output: seven 16-bit words per 100 msec

Table 3-2A. AMSU-A2 Digital A Data Format - Full Scan Mode (1 of 3)

A2 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Position 1, MSP, First reading
10	Reflector, Position 1, LSP, First reading
11	Reflector, Position 1, MSP, Second reading
12	Reflector, Position 1, LSP, Second reading
13	Scene Position 1, Channel 1, MSP
14	Scene Position 1, Channel 1, LSP
15	Scene Position 1, Channel 2, MSP
16	Scene Position 1, Channel 2, LSP

Table 3-2A. AMSU-A2 Digital A Data Format - Full Scan Mode (2 of 3)

17	Reflector, Position 2, MSP, First reading
18	Reflector, Position 2, LSP, First reading
19	Reflector, Position 2, MSP, Second reading
20	Reflector, Position 2, LSP, Second reading
21	Scene Position 2, Channel 1, MSP
22	Scene Position 2, Channel 1, LSP
23	Scene Position 2, Channel 2, MSP
24	Scene Position 2, Channel 2, LSP
25	Reflector, Position 3, MSP, First reading
26	Reflector, Position 3, LSP, First reading
27	Reflector, Position 3, MSP, Second reading
28	Reflector, Position 3, LSP, Second reading
29	Scene Position 3, Channel 1, MSP
30	Scene Position 3, Channel 1, LSP
31	Scene Position 3, Channel 2, MSP
32	Scene Position 3, Channel 2, LSP
33-248	Bytes 25 through 32 are repeated for Positions 4 through 30
249	Reflector, Cold Cal. Position, MSP, First reading
250	Reflector, Cold Cal. Position, LSP, First reading
251	Reflector, Cold Cal. Position, MSP, Second reading
252	Reflector, Cold Cal. Position, LSP, Second reading
253	Cold Calibration 1, Channel 1, MSP
254	Cold Calibration 1, Channel 1, LSP
255	Cold Calibration 1, Channel 2, MSP
256	Cold Calibration 1, Channel 2, LSP
257	Cold Calibration 2, Channel 1, MSP
258	Cold Calibration 2, Channel 1, LSP
259	Cold Calibration 2, Channel 2, MSP
260	Cold Calibration 2, Channel 2, LSP
261	Temp Sensor 1, MSP
262	Temp Sensor 1, LSP
263	Temp Sensor 2, MSP
264	Temp Sensor 2, LSP
265-298	Bytes 263 & 264 are repeated for Sensors 3 through 19

Table 3-2A. AMSU-A2 Digital A Data Format - Full Scan Mode (3 of 3)

299	Temp Sensor Reference Voltage, MSP
300	Temp Sensor Reference Voltage, LSP
301	Reflector Warm Cal. Position, MSP, First reading
302	Reflector Warm Cal. Position, LSP, First reading
303	Reflector Warm Cal. Position, MSP, Second reading
304	Reflector Warm Cal. Position, LSP, Second reading
305	Warm Calibration 1, Channel 1, MSP
306	Warm Calibration 1, Channel 1, LSP
307	Warm Calibration 1, Channel 2, MSP
308	Warm Calibration 1, Channel 2, LSP
309	Warm Calibration 2, Channel 1, MSP
310	Warm Calibration 2, Channel 1, LSP
311	Warm Calibration 2, Channel 2, MSP
312	Warm Calibration 2, Channel 2, LSP
313-315	Sync. Sequence (FF Hex)
316	Unit Identification and Serial Number

NOTE

1. In the above table the MSP is the most significant portion of a particular measurement while the LSP is the least significant portion of the particular measurement.
2. In the above table the first set of readings for a particular reflector position are made prior to the integration interval, while the second set of readings are made approximately 1/2 way through the integration period.
3. Digital A data as read by the spacecraft contains an undetermined number of fill words. These fill words are 0001H and will be intermingled with valid data. The Digital A data as sent by the instrument is such that no valid data of 0001H is included.
4. Format of Position data is:
DDDDDDDDDDDDDDDE0
D = Data
E = Error bit, 0 = not in spec, 1 = in spec
0 = zero
5. Format of Radiometer data is:
DDDDDDDDDDDDDDDD0
D = Data, 0 = zero
6. The temperature sensor reference voltage is utilized for temperature sensors 13 through 19 only.

Table 3-2B. AMSU-A2 Digital A Data Format - Warm Cal Mode

A2 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Warm Cal. Position, MSP, First reading
10	Reflector, Warm Cal. Position, LSP, First reading
11	Reflector, Warm Cal. Position, MSP, Second reading
12	Reflector, Warm Cal. Position, LSP, Second reading
13	Warm Cal. Position, Channel 1, MSP
14	Warm Cal. Position, Channel 1, LSP
15	Warm Cal. Position, Channel 2, MSP
16	Warm Cal. Position, Channel 2, LSP
17-248	Bytes 9 through 16 are repeated 29 times for a total of 30 data sets.
249	Temp Sensor 1, MSP
250	Temp Sensor 1, LSP
251	Temp Sensor 2, MSP
252	Temp Sensor 2, LSP
253-286	Bytes 251 & 252 are repeated for Sensors 3 through 19
287	Temp Sensor Reference Voltage, MSP
288	Temp Sensor Reference Voltage, LSP
Refer to the note from Table 3-2A	

Table 3-2C. AMSU-A2 Digital A Data Format - Cold Cal Mode

A2 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Cold Cal. Position, MSP, First reading
10	Reflector, Cold Cal. Position, LSP, First reading
11	Reflector, Cold Cal. Position, MSP, Second reading
12	Reflector, Cold Cal. Position, LSP, Second reading
13	Cold Cal. Position 1, Channel 1, MSP
14	Cold Cal. Position 1, Channel 1, LSP
15	Cold Cal. Position 1, Channel 2, MSP
16	Warm Cal. Position 1, Channel 2, LSP
17-248	Bytes 9 through 16 are repeated 29 times for a total of 30 data sets.
249	Temp Sensor 1, MSP
250	Temp Sensor 1, LSP
251	Temp Sensor 2, MSP
252	Temp Sensor 2, LSP
253-286	Bytes 251 & 252 are repeated for Sensors 3 through 19
287	Temp Sensor Reference Voltage, MSP
288	Temp Sensor Reference Voltage, LSP
Refer to note from Table 3-2A.	

Table 3-2D. AMSU-A2 Digital A Data Format - Nadir Mode

A2 Frame Byte No.	Parameter
1-3	Sync. Sequence (FF Hex)
4	Unit Identification and Serial Number
5	Digital Housekeeping Data 1
6	Digital Housekeeping Data 2
7	Digital Housekeeping Data 3
8	Digital Housekeeping Data 4
9	Reflector, Position 15, MSP, First reading
10	Reflector, Position 15, LSP, First reading
11	Reflector, Position 15, MSP, Second reading
12	Reflector, Position 15, LSP, Second reading
13	Nadir Position, Channel 1, MSP
14	Nadir Position, Channel 1, LSP
15	Nadir Position, Channel 2, MSP
16	Nadir Position, Channel 2, LSP
17-248	Bytes 9 through 16 are repeated 29 times for a total of 30 data sets.
249	Temp Sensor 1, MSP
250	Temp Sensor 1, LSP
251	Temp Sensor 2, MSP
252	Temp Sensor 2, LSP
253-286	Bytes 251 & 252 are repeated for Sensors 3 through 19
287	Temp Sensor Reference Voltage, MSP
288	Temp Sensor Reference Voltage, LSP
Refer to note from Table 3-2A.	

Table 3-2E. AMSU-A2 Data Word Description (1 of 2)

Bit	Description
Digital Housekeeping Data, Byte Number 1	
0	0
1	Full Scan Mode. 0 = Not Full Scan, 1 = Full Scan
2	Warm Cal Mode. 0 = Not in Warm Cal, 1 = Warm Cal
3	Cold Cal Mode. 0 = Not in Cold Cal, 1 = Cold Cal
4	Nadir Mode. 0 = Not in Nadir, 1 = Nadir
5	Cold Cal Position, LSB
6	Cold Cal Position, MSB
7	0.
Digital Housekeeping Data, Byte Number 2	
0	0
1	Scanner A2 Power 0 = Off, 1 = On.
2	Scanner Compensator Power 0 = Off, 1 = On.
3	0.
4	Survival Heater Power 0 = Off, 1 = On
5	0.
6	0.
7	0.
Digital Housekeeping Data, Byte Number 3	
0	0.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.
Digital Housekeeping Data, Byte Number 4	
0	0.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.

Table 3-2E. AMSU-A2 Data Word Description (2 of 2)

AMSU-A2 Temperature Sensor Assignments	
Number	Location
1	Scan Motor
2	Feed Horn
3	RF Mux
4	Mixer IF Amplifier Channel 1
5	Mixer IF Amplifier Channel 2
6	Local Oscillator Channel 1
7	Local Oscillator Channel 2
8	Compensation Motor
9	Subreflector
10	DC/DC Converter
11	RF Shelf
12	Detector/Preamplifier Assembly
13	Warm load center
14	Warm load 1
15	Warm load 2
16	Warm load 3
17	Warm load 4
18	Warm load 5
19	Warm load 6

AMSU-A2 Identification Words	
Unit No.	Identification No. (Binary)
Engineering Model Module A-2	00000010
Protoflight Model Module A-2	00000110
Flight Model 1 Module A-2	00001010
Flight Model 2 Module A-2	00001110

3.2.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcoms generated by the TIP sample each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GISS.

Words 8 and 12 of the TIP Minor Frame (AIP Minor Frame Words 111 and 115) are dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.2.3.1 Digital B Telemetry Points

Ten Digital B Telemetry Points are required by the AMSU-A2. The Digital B Telemetry Points provided are as shown Table 3-2F.

Table 3-2F. AMSU-A2 Digital B Telemetry

No.	Telemetry Point Name	State		Chan. #
		*Logic "1"	Logic "0"	
1	Scanner Power ON/OFF**	ON	OFF	31
2	Antenna in Warm Cal Position YES/NO	YES	NO	55
3	Antenna in Cold Cal Position YES/NO	YES	NO	65
4	Antenna in Nadir Position YES/NO	YES	NO	93
5	Full Scan YES/NO	YES	NO	94
6	Module Power**	CONNECT	DISCONNECT	96
7	Compensator Motor ON/OFF**	ON	OFF	99
8	Survival Heater ON/OFF**	ON	OFF	102
9	Cold Cal Position MSB	SEE NOTE		107
10	Cold Cal Position LSB			115

* Logic "1" is a "Low Voltage" State

** Must correctly indicate power status with instrument power off.

MSB LSB

0	0	6.667 degrees from -Z
0	1	8.333 degrees from -Z
1	0	9.999 degrees from -Z
1	1	13.332 degrees from -Z

If telemetry points 2, 3, 4 & 5 all indicate Logic "0", the instrument is operating with the antenna in warm cal position.

3.2.4 Analog Telemetry

The Analog Telemetry needed when instrument power is off is available at the instrument interface at all times.

Three different subcoms types (32, 16 and 1 second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GIIIS. AMSU-A2 shall use the 16-second analog subcoms.

3.2.4.1 Analog Telemetry Points

Analog Telemetry Points used by the AMSU-A2 are as shown in Table 3-2G. Descriptions of each telemetry point are detailed below.

The AMSU-A2 is provided fifteen analog channels to monitor the health of the instrument.

3.2.4.2 Exceptions

The instrument output signals conform to Sections 3.1.6 and 3.1.8 of the GIIIS. The exceptions to the above specification are as follows: None

Table 3-2G. AMSU-A2 Analog Telemetry

No.	Telemetry Point Name	Range Scale Factor		CH # (MNF#)
		Red (Low/High)	Yellow(Low/High)	
1	Scanner Motor Temperature*	-30°C/58°C	-20°C/66°C	451 (67)
2	Compensator Motor Temperature*	-30°C/58°C	-20°C/66°C	452 (68)
3	RF Shelf Temperature*	-30°C/58°C	-20°C/66°C	453 (69)
	Warm Load A2*	-30°C/58°C	-20°C/66°C	455 (71)
		Minimum/Low	Maximum/High	
5	Compensator Motor Current (Average)	50 mA	214 mA	459 (75)
6	Antenna Drive Motor Current (Average)	50 mA	214 mA	460 (76)
7	+15 VDC (Signal Processing)	14.0 V	16.0 V	461 (77)
8	+15 VDC (Antenna Drive)	13.5 V	18.0 V	463 (79)
9	-15 VDC (Signal Processing)	-16.0 V	-14.0 V	466 (82)
10	-15 VDC (Antenna Drive)	-16.5 V	-13.5 V	468 (84)
11	+8 VDC (Receiver)	7.0 V	9.0 V	469 (85)
12	+5 VDC (Signal Processing)	4.0 V	6.0 V	471 (87)
13	+5 VDC (Antenna Drive)	4.0 V	6.0 V	474 (90)
14	GDO Voltage Ch 1 (23.8 GHz)	7.0 V	9.0 V	476 (92)
15	GDO Voltage Ch 2 (31.4 GHz)	6.0 V	8.0 V	477 (93)
* Powered by the +28V Analog TLM B				
** These limits pertain to AMSU-A2, P/N 1331200, S/N 103, & 104				

3.3 Advance Microwave Sounder Unit (AMSU-B)

3.3.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft are assignable into three categories; Digital A Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the AMSU-B are as detailed below:

3.3.2 Digital A Data

Digital A data is clocked into the spacecraft AIP at a 16.64 kb/sec rate by the shift pulse (C_1) whenever the Data Enable Pulse (A_1) is presented to the instrument. The AMSU-B data will be AIP minor frame words 48 through 97.

The AIP will read the digital data output from the AMSU-B in 16 bit words. The instrument shall not routinely put out as many as sixty "0's" or sixty "1's" in a row.

The AMSU-B telemetry format shall consist of 78 minor frames of data. Minor frames 1 and 80 in each 8 second cycle are blank; i.e. no data is available in the PEU digital data FIFO during the first and last minor frames of each 8 second format.

The 78 minor frames are organized as 3 blocks of 650 words as follows (representing one scan of the instrument):

36 spare words

540 words of Earth view pixel data

(90 x (5 channels + shaft position at mid-pixel))

26 words of housekeeping data

48 words of space view and target view data

(2 x 4 x (5 channels + shaft position))

This structure is maintained for all modes. In static modes all pixel data locations shall contain the pixel data for the current antenna position.

The AMSU-B digital format is synchronized to the 8 second synchronization pulse. During each minor frame, 25 words of data are available in the PEU O/P FIFO within 16.7 ms of the start of the minor frame (except in minor frames 1 and 80).

3.3.2.1 General Requirements

- a. Content: A description of the digital data is provided in Table 3-3B. There are two types of digital format which are described in Table 3-3A:
 - 1. Normal Format - This format is available in the Scan Normal Mode.
 - 2. Park Format - This format is available in Scan Park and Scan Step modes.
- b. Word Length: 16 bits
- c. Serial Output: twenty-five 16 bit words per 100 msec (MSB first).

3.3.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcoms generated by the TIP will sample each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

Words 8 and 12 of the Minor Frame will be dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.3.3.1 Digital B Telemetry Points

The AMSU-B instrument will be provided 16 Digital B telemetry points. The Digital B Telemetry Points provided are as shown in Table 3-3C.

3.3.4 Analog Telemetry

A 16 second subcom generated by the TIP will be used to sample all AMSU-B analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

3.3.4.1 Analog Telemetry Points

The Analog Telemetry Points used by the AMSU-B are shown in Table 3-3D.

The AMSU-B will be provided 18 Analog Telemetry channels to monitor health and safety.

3.3.4.2 Exceptions

The instrument output signals conform to Sections 3.1.6 and 3.1.8 of the GLIS. The exceptions to the above specification are as follows:

NONE

Table 3-3A. AMSU-B Digital A Data Format (1 of 4)

Minor Frame	1	2	3	4	5	6	7	8	9	10
Word 01	Blank	SP1	SP26	17/03	18/07	19/11	20/15	P/20	16/24	17/28
Word 02		SP2	SP27	18/03	19/07	20/11	P/16	16/20	17/24	18/28
Word 03		SP3	SP28	19/03	20/07	P/12	16/16	17/20	18/24	19/28
Word 04		SP4	SP29	20/03	P/08	16/12	17/16	18/20	19/24	20/28
Word 05		SP5	SP30	P/04	16/08	17/12	18/16	19/20	20/24	P/29
Word 06		SP6	SP31	16/04	17/08	18/12	19/16	20/20	P/25	16/29
Word 07		SP7	SP32	17/04	18/08	19/12	20/16	P/21	16/25	17/29
Word 08		SP8	SP33	18/04	19/08	20/12	P/17	16/21	17/25	18/29
Word 09		SP9	SP34	19/04	20/08	P/13	16/17	17/21	18/25	19/29
Word 10		SP10	SP35	20/04	P/09	16/13	17/17	18/21	19/25	20/29
Word 11		SP11	SP36	P/05	16/09	17/13	18/17	19/21	20/25	P/30
Word 12		SP12	P/01	16/05	17/09	18/13	19/17	20/21	P/26	16/30
Word 13		SP13	16/01	17/05	18/09	19/13	20/17	P/22	16/26	17/30
Word 14		SP14	17/01	18/05	19/09	20/13	P/18	16/22	17/26	18/30
Word 15		SP15	18/01	19/05	20/09	P/14	16/18	17/22	18/26	19/30
Word 16		SP16	19/01	20/05	P/10	16/14	17/18	18/22	19/26	20/30
Word 17		SP17	20/01	P/06	16/10	17/14	18/18	19/22	20/26	P/31
Word 18		SP18	P/02	16/06	17/10	18/14	19/18	20/22	P/27	16/31
Word 19		SP19	16/02	17/06	18/10	19/14	20/18	P/23	16/27	17/31
Word 20		SP20	17/02	18/06	19/10	20/14	P/19	16/23	17/27	18/31
Word 21		SP21	18/02	19/06	20/10	P/15	16/19	17/23	18/27	19/31
Word 22		SP22	19/02	20/06	P/11	16/15	17/19	18/23	19/27	20/31
Word 23		SP23	20/02	P/07	16/11	17/15	18/19	19/23	20/27	P/32
Word 24		SP24	P/03	16/07	17/11	18/15	19/19	20/23	P/28	16/32
Word 25		SP25	16/03	17/07	18/11	19/15	20/19	P/24	16/28	17/32

Minor Frame	11	12	13	14	15	16	17	18	19	20
Word 01	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61	20/65	P/70
Word 02	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61	P/66	16/70
Word 03	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62	16/66	17/70
Word 04	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62	17/66	18/70
Word 05	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62	18/66	19/70
Word 06	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62	19/66	20/70
Word 07	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62	20/66	P/71
Word 08	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62	P/67	16/71
Word 09	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63	16/67	17/71
Word 10	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63	17/67	18/71
Word 11	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63	18/67	19/71
Word 12	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63	19/67	20/71
Word 13	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63	20/67	P/72
Word 14	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63	P/68	16/72
Word 15	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64	16/68	17/72
Word 16	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64	17/68	18/72
Word 17	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64	18/68	19/72
Word 18	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64	19/68	20/72
Word 19	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64	20/68	P/73
Word 20	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64	P/69	16/73
Word 21	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65	16/69	17/73
Word 22	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65	17/69	18/73
Word 23	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65	18/69	19/73
Word 24	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65	19/69	20/73
Word 25	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65	20/69	P/74

Table 3-3A. AMSU-B Digital A Data Format (2 of 4)

Minor Frame	21	22	23	24	25	26	27	28	29	30
Word 01	16/74	17/78	18/82	19/86	20/90	A25	20/S4	SP1	TST09	17/03
Word 02	17/74	18/78	19/82	20/86	A01	A26	P/T1	SP2	TST10	18/03
Word 03	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	SP3	TST11	19/03
Word 04	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	SP4	TST12	20/03
Word 05	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	SP5	TST13	P/04
Word 06	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	SP6	TST14	16/04
Word 07	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	SP7	TST15	17/04
Word 08	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	SP8	TST16	18/04
Word 09	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	SP9	TST17	19/04
Word 10	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	SP10	TST18	20/04
Word 11	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	SP11	TST19	P/05
Word 12	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	SP12	P/01	16/05
Word 13	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	SP13	16/01	17/05
Word 14	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	SP14	17/01	18/05
Word 15	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	SP15	18/01	19/05
Word 16	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	SP16	19/01	20/05
Word 17	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	SP17	20/01	P/06
Word 18	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	TST01	P/02	16/06
Word 19	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	TST02	16/02	17/06
Word 20	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	TST03	17/02	18/06
Word 21	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	TST04	18/02	19/06
Word 22	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	TST05	19/02	20/06
Word 23	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	TST06	20/02	P/07
Word 24	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	TST07	P/03	16/07
Word 25	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	TST08	16/03	17/07

Minor Frame	31	32	33	34	35	36	37	38	39	40
Word 01	18/07	19/11	20/15	P/20	16/24	17/28	18/32	19/36	20/40	P/45
Word 02	19/07	20/11	P/16	16/20	17/24	18/28	19/32	20/36	P/41	16/45
Word 03	20/07	P/12	16/16	17/20	18/24	19/28	20/32	P/37	16/41	17/45
Word 04	P/08	16/12	17/16	18/20	19/24	20/28	P/33	16/37	17/41	18/45
Word 05	16/08	17/12	18/16	19/20	20/24	P/29	16/33	17/37	18/41	19/45
Word 06	17/08	18/12	19/16	20/20	P/25	16/29	17/33	18/37	19/41	20/45
Word 07	18/08	19/12	20/16	P/21	16/25	17/29	18/33	19/37	20/41	P/46
Word 08	19/08	20/12	P/17	16/21	17/25	18/29	19/33	20/37	P/42	16/46
Word 09	20/08	P/13	16/17	17/21	18/25	19/29	20/33	P/38	16/42	17/46
Word 10	P/09	16/13	17/17	18/21	19/25	20/29	P/34	16/38	17/42	18/46
Word 11	16/09	17/13	18/17	19/21	20/25	P/30	16/34	17/38	18/42	19/46
Word 12	17/09	18/13	19/17	20/21	P/26	16/30	17/34	18/38	19/42	20/46
Word 13	18/09	19/13	20/17	P/22	16/26	17/30	18/34	19/38	20/42	P/47
Word 14	19/09	20/13	P/18	16/22	17/26	18/30	19/34	20/38	P/43	16/47
Word 15	20/09	P/14	16/18	17/22	18/26	19/30	20/34	P/39	16/43	17/47
Word 16	P/10	16/14	17/18	18/22	19/26	20/30	P/35	16/39	17/43	18/47
Word 17	16/10	17/14	18/18	19/22	20/26	P/31	16/35	17/39	18/43	19/47
Word 18	17/10	18/14	19/18	20/22	P/27	16/31	17/35	18/39	19/43	20/47
Word 19	18/10	19/14	20/18	P/23	16/27	17/31	18/35	19/39	20/43	P/48
Word 20	19/10	20/14	P/19	16/23	17/27	18/31	19/35	20/39	P/44	16/48
Word 21	20/10	P/15	16/19	17/23	18/27	19/31	20/35	P/40	16/44	17/48
Word 22	P/11	16/15	17/19	18/23	19/27	20/31	P/36	16/40	17/44	18/48
Word 23	16/11	17/15	18/19	19/23	20/27	P/32	16/36	17/40	18/44	19/48
Word 24	17/11	18/15	19/19	20/23	P/28	16/32	17/36	18/40	19/44	20/48
Word 25	18/11	19/15	20/19	P/24	16/28	17/32	18/36	19/40	20/44	P/49

Table 3-3A. AMSU-B Digital A Data Format (3 of 4)

Minor Frame	41	42	43	44	45	46	47	48	49	50
Word 01	16/49	17/53	18/57	19/61	20/65	P/70	16/74	17/78	18/82	19/86
Word 02	17/49	18/53	19/57	20/61	P/66	16/70	17/74	18/78	19/82	20/86
Word 03	18/49	19/53	20/57	P/62	16/66	17/70	18/74	19/78	20/82	P/87
Word 04	19/49	20/53	P/58	16/62	17/66	18/70	19/74	20/78	P/83	16/87
Word 05	20/49	P/54	16/58	17/62	18/66	19/70	20/74	P/79	16/83	17/87
Word 06	P/50	16/54	17/58	18/62	19/66	20/70	P/75	16/79	17/83	18/87
Word 07	16/50	17/54	18/58	19/62	20/66	P/71	16/75	17/79	18/83	19/87
Word 08	17/50	18/54	19/58	20/62	P/67	16/71	17/75	18/79	19/83	20/87
Word 09	18/50	19/54	20/58	P/63	16/67	17/71	18/75	19/79	20/83	P/88
Word 10	19/50	20/54	P/59	16/63	17/67	18/71	19/75	20/79	P/84	16/88
Word 11	20/50	P/55	16/59	17/63	18/67	19/71	20/75	P/80	16/84	17/88
Word 12	P/51	16/55	17/59	18/63	19/67	20/71	P/76	16/80	17/84	18/88
Word 13	16/51	17/55	18/59	19/63	20/67	P/72	16/76	17/80	18/84	19/88
Word 14	17/51	18/55	19/59	20/63	P/68	16/72	17/76	18/80	19/84	20/88
Word 15	18/51	19/55	20/59	P/64	16/68	17/72	18/76	19/80	20/84	P/89
Word 16	19/51	20/55	P/60	16/64	17/68	18/72	19/76	20/80	P/85	16/89
Word 17	20/51	P/56	16/60	17/64	18/68	19/72	20/76	P/81	16/85	17/89
Word 18	P/52	16/56	17/60	18/64	19/68	20/72	P/77	16/81	17/85	18/89
Word 19	16/52	17/56	18/60	19/64	20/68	P/73	16/77	17/81	18/85	19/89
Word 20	17/52	18/56	19/60	20/64	P/69	16/73	17/77	18/81	19/85	20/89
Word 21	18/52	19/56	20/60	P/65	16/69	17/73	18/77	19/81	20/85	P/90
Word 22	19/52	20/56	P/61	16/65	17/69	18/73	19/77	20/81	P/86	16/90
Word 23	20/52	P/57	16/61	17/65	18/69	19/73	20/77	P/82	16/86	17/90
Word 24	P/53	16/57	17/61	18/65	19/69	20/73	P/78	16/82	17/86	18/90
Word 25	16/53	17/57	18/61	19/65	20/69	P/74	16/78	17/82	18/86	19/90

Minor Frame	51	52	53	54	55	56	57	58	59	60
Word 01	20/90	A25	20/S4	SP1	TST09	17/03	18/07	19/11	20/15	P/20
Word 02	A01	A26	P/T1	SP2	TST10	18/03	19/07	20/11	P/16	16/20
Word 03	A02	P/S1	16/T1	SP3	TST11	19/03	20/07	P/12	16/16	17/20
Word 04	A03	16/S1	17/T1	SP4	TST12	20/03	P/08	16/12	17/16	18/20
Word 05	A04	17/S1	18/T1	SP5	TST13	P/04	16/08	17/12	18/16	19/20
Word 06	A05	18/S1	19/T1	SP6	TST14	16/04	17/08	18/12	19/16	20/20
Word 07	A06	19/S1	20/T1	SP7	TST15	17/04	18/08	19/12	20/16	P/21
Word 08	A07	20/S1	P/T2	SP8	TST16	18/04	19/08	20/12	P/17	16/21
Word 09	A08	P/S2	16/T2	SP9	TST17	19/04	20/08	P/13	16/17	17/21
Word 10	A09	16/S2	17/T2	SP10	TST18	20/04	P/09	16/13	17/17	18/21
Word 11	A10	17/S2	18/T2	SP11	TST19	P/05	16/09	17/13	18/17	19/21
Word 12	A11	18/S2	19/T2	SP12	P/01	16/05	17/09	18/13	19/17	20/21
Word 13	A12	19/S2	20/T2	SP13	16/01	17/05	18/09	19/13	20/17	P/22
Word 14	A13	20/S2	P/T3	SP14	17/01	18/05	19/09	20/13	P/18	16/22
Word 15	A14	P/S3	16/T3	SP15	18/01	19/05	20/09	P/14	16/18	17/22
Word 16	A15	16/S3	17/T3	SP16	19/01	20/05	P/10	16/14	17/18	18/22
Word 17	A16	17/S3	18/T3	SP17	20/01	P/06	16/10	17/14	18/18	19/22
Word 18	A17	18/S3	19/T3	TST01	P/02	16/06	17/10	18/14	19/18	20/22
Word 19	A18	19/S3	20/T3	TST02	16/02	17/06	18/10	19/14	20/18	P/23
Word 20	A19	20/S3	P/T4	TST03	17/02	18/06	19/10	20/14	P/19	16/23
Word 21	A20	P/S4	16/T4	TST04	18/02	19/06	20/10	P/15	16/19	17/23
Word 22	A21	16/S4	17/T4	TST05	19/02	20/06	P/11	16/15	17/19	18/23
Word 23	A22	17/S4	18/T4	TST06	20/02	P/07	16/11	17/15	18/19	19/23
Word 24	A23	18/S4	19/T4	TST07	P/03	16/07	17/11	18/15	19/19	20/23
Word 25	A24	19/S4	20/T4	TST08	16/03	17/07	18/11	19/15	20/19	P/24

Table 3-3A. AMSU-B Digital A Data Format (4 of 4)

Minor Frame	61	62	63	64	65	66	67	68	69	70
Word 01	16/24	17/28	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61
Word 02	17/24	18/28	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61
Word 03	18/24	19/28	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62
Word 04	19/24	20/28	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62
Word 05	20/24	P/29	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62
Word 06	P/25	16/29	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62
Word 07	16/25	17/29	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62
Word 08	17/25	18/29	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62
Word 09	18/25	19/29	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63
Word 10	19/25	20/29	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63
Word 11	20/25	P/30	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63
Word 12	P/26	16/30	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63
Word 13	16/26	17/30	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63
Word 14	17/26	18/30	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63
Word 15	18/26	19/30	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64
Word 16	19/26	20/30	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64
Word 17	20/26	P/31	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64
Word 18	P/27	16/31	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64
Word 19	16/27	17/31	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64
Word 20	17/27	18/31	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64
Word 21	18/27	19/31	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65
Word 22	19/27	20/31	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65
Word 23	20/27	P/32	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65
Word 24	P/28	16/32	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65
Word 25	16/28	17/32	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65

Minor Frame	71	72	73	74	75	76	77	78	79	80
Word 01	20/65	P/70	16/74	17/78	18/82	19/86	20/90	A25	20/S4	Blank
Word 02	P/66	16/70	17/74	18/78	19/82	20/86	A01	A26	P/T1	
Word 03	16/66	17/70	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	
Word 04	17/66	18/70	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	
Word 05	18/66	19/70	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	
Word 06	19/66	20/70	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	
Word 07	20/66	P/71	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	
Word 08	P/67	16/71	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	
Word 09	16/67	17/71	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	
Word 10	17/67	18/71	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	
Word 11	18/67	19/71	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	
Word 12	19/67	20/71	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	
Word 13	20/67	P/72	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	
Word 14	P/68	16/72	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	
Word 15	16/68	17/72	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	
Word 16	17/68	18/72	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	
Word 17	18/68	19/72	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	
Word 18	19/68	20/72	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	
Word 19	20/68	P/73	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	
Word 20	P/69	16/73	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	
Word 21	16/69	17/73	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	
Word 22	17/69	18/73	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	
Word 23	18/69	19/73	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	
Word 24	19/69	20/73	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	
Word 25	20/69	P/74	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	

NOTE (Table 3-3A)

The format consists of 80 minor frames (1 to 80). Minor frames 1 and 80 are blank. No data is available in the PEU output FIFO for reading by the AIP and therefore the AIP does not send any sample pulses to AMSU-B during these minor frame periods.

The following key applies:

SP	:	Spare word (Data is 5555H)
TSTXX	:	Test data
P/n	:	Shaft position at mid-integration time for FOV n.
16/n	:	Integrated output for channel 16 for FOV n.
17/n	:	Integrated output for channel 17 for FOV n.
18/n	:	Integrated output for channel 18 for FOV n.
19/n	:	Integrated output for channel 19 for FOV n.
20/n	:	Integrated output for channel 20 for FOV n.
/Sn	:	Space view for FOV n.
/Tn	:	Target view for FOV n.
AXX	:	Multiplexed Housekeeping data

The format structure and definition is identical for all modes. In scanning modes, n, Sn & Tn represent pixel identification. In static modes n, Sn & Tn have no meaning; all data values relate to the IFOV.

Table 3-3B. AMSU-B Data Word Description (1 of 2)

Digital Submultiplexed Channels	
A01	Unit ID + Flags
A02	Digital B Telemetry
A03	Mixer 16 temperature
A04	Mixer 17 temperature
A05	Mixer 18/19/20 temperature
A06	FET amplifier 16 temperature
A07	FET amplifier 17 temperature
A08	FET amplifier 18 temperature
A09	FET amplifier 19 temperature
A10	FET amplifier 20 temperature
A11	Calibration target temperature 1
A12	Calibration target temperature 2
A13	Calibration target temperature 3
A14	Calibration target temperature 4
A15	Calibration target temperature 5
A16	Calibration target temperature 6
A17	Calibration target temperature 7
A18	Sub-reflector temperature 1
A19	Local Oscillator Monitor Current 16
A20	Local Oscillator Monitor Current 17
A21	Local Oscillator Monitor Current 18/19/20
A22	Local Oscillator 16 temperature
A23	Local Oscillator 17 temperature
A24	Local Oscillator 18/19/20 temperature
A25	PRT Bridge Voltage
A26	PRT Board Temperature

Table 3-3B. AMSU-B Data Word Description (2 of 2)

Bit	A01			
00	Module ID (LSB)	Unit Number	Identification Number	
01	Module ID			
02	Module ID		(MSB)	(LSB)
03	Module ID	EM	0000	0000
04	Module ID	PFM	0000	0100
05	Module ID	FM2	0000	1000
06	Module ID	FM3	0000	1100
07	Module ID (MSB)			
08	Mode Transition Flag: 0- Transition Complete; 1- Transition in progress			
09	Scan Synchronization: 0 - Error ≥ 0.1 degrees at 8 sec. sync pulse 1 - Error ≥ 0.1 degrees at 8 sec. sync pulse			
10	Pixel Data Invalid Flag: 0 - Valid; 1 - Invalid			
11	Scan Control Status: 0 - Running; 1 - Aborted			
12	Processor Check Flag: 0 - Built-In-Test passed; 1 - Built-In Test failed			
13	Not Defined			
14	Not Defined			
15(MSB)	MDE Power ON/OFF (Relay 6 Status)			
Bit	A02 (A '1' status indicates "ON" and a "0" status indicates "OFF")			
00	Power ON/OFF (Relay 1 status)			
01	Survival heater ON/OFF (Relay 2 status)			
02	Scan normal mode			
03	Parked in target view mode			
04	Parked in nadir view mode			
05	Parked in space view mode			
06	Investigation mode			
07	Stepped Mode			
08	Channel 16 ON/OFF (Relay 3 status)			
09	Channel 17 ON/OFF (Relay 4 status)			
10	Channel 18/19/20 ON/OFF (Relay 5 status)			
11	Space view select (MSB)			
12	Space view select (LSB)			
13	Memory checks status			
14	ROM check flag			
15 (MSB)	RAM check flag			

Table 3-3C. AMSU-B Digital B Telemetry

No.	Telemetry Point Name	State*		CH #
		Logic "1"	Logic "0"	
1	Power ON/OFF	ON	OFF	119
2	Survival Heater ON/OFF	ON	OFF	126
3	Scan Normal Mode	YES	NO	127
4	Parked in Target View Mode	YES	NO	134
5	Parked in Nadir View Mode	YES	NO	151
6	Parked in Space View Mode	YES	NO	158
7	Investigation Mode	YES	NO	166
8	Stepped Mode	YES	NO	182
9	Channel 16 ON/OFF	ON	OFF	187
10	Channel 17 ON/OFF	ON	OFF	190
11	Channel 18/19/20 ON/OFF	ON	OFF	191
12	Space View Select (MSB)	Logic 1	Logic 0	197
13	Space View Select (LSB)	Logic 1	Logic 0	213
14	Memory Checks Status	Enabled	Disabled	246
15	ROM Check Flag	Failed	Passed	249
16	RAM Check Flag	Failed	Passed	255
*Logic "1" is a "Low Voltage" State				

Table 3-3D. AMSU-B Analog Telemetry

No.	Telemetry Point Name	Range**	CH # (subcom)
1	+12V (A) Secondary	12 +/- 0.72v	279(16-1)
2	-12V (A) Secondary	-12 +/- 0.72v	493(16-2)
3	+15V (A) Secondary	15 +/- 0.15v	496(16-2)
4	-15V (A) Secondary	-15 +/- 0.15v	500(16-2)
5	+8V (A) Secondary	8.0 +/- 0.1v	501(16-2)
6	+5V (D) Secondary	5.0 +/- 0.1v	504(16-2)
7	+5V (A) Secondary	5.0 +/- 0.1v	507(16-2)
8	-5V (A) Secondary	-5.0 +/- 0.1v	508(16-2)
9	+5V Reference Secondary	-5.0 +/- 0.1v	509(16-2)
10	ICE Temperature	23.3 +/- 3.5°C	317(16-1)
11	MDE Temperature	23.1 +/- 3.5°C	333(16-1)
12	PEU Temperature	25.2 +/- 3.5°C	365(16-1)
13	PSU Temperature	32.5 +/- 3.5°C	373(16-1)
14	Scan Motor Temperature	22.3 +/- 3.4°C	381(16-1)
15	Scan Motor Current	***	447(16-2)
16	Local Oscillator Temperature Ch 16*	33.0 +/- 5.0°C	483(16-2)
17	Local Oscillator Temperature Ch 17*	33.0 +/- 5.0°C	484(16-2)
18	Local Oscillator Temperature Ch 18/19/20*	33.0 +/- 5.0°C	485(16-2)
<p>* Power by the +28V Analog TLM Bus.</p> <p>*** 3 months prior to delivery of any flight model to LMAS. (Above limits are for FM-1)</p> <p>** Highly variable during any antenna scan.</p>			

3.4 Advanced Very High Resolution Radiometer (AVHRR/3)

3.4.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft fall into three categories; outputs to the MIRP, Digital B telemetry, and analog telemetry. The specific signals supplied by the AVHRR/3 are detailed below.

3.4.2 AVHRR/3 Outputs to the MIRP

The data from each of the five channels is digitized in the radiometer to a 10-bit word and brought out of the instrument as a 10-bit parallel digital output to the spacecraft MIRP. In addition to these digital signals, the line synchronization signal is also routed to the MIRP on a separate buffer isolated line.

3.4.3 Line Synchronization Pulse

A line synchronization pulse is sent to the MIRP at the beginning of each mirror scan. The characteristics of this pulse are as follows:

- a. Duration: 100 microseconds.
- b. Repetition Rate: 6 pps.
- c. Noise Spikes: Less than 1/4 signal amplitude
- d. Scan Line to Scan Line Jitter:
 - 1. Less than 17.2 msec for 98 percent of jitter measurements are taken for adjacent scan lines over a 20-minute period
 - 2. Less than 34.4 msec between any two scan lines within a 20-minute period.
- e. Interface Circuit:

Standard TTL gate, type SN5440. This logic element is powered by +5 volts from the AVHRR/3 power converter and referenced to signal ground.
- f. Pulse Level:

The sync line output is normally at ground level (0.0 to +0.4V). The sync line output transitions to the +5V level (+2.40 to +5.25V) for the duration of each sync pulse.
- g. Shielding:

The shield of the sync line is tied to AVHRR/3 chassis ground.

3.4.3.1 Radiometric Data Lines

A separate analog video signal is generated within the AVHRR/3 for each of the radiometric channels in the instrument. The data for each channel is converted to a single 10-bit digital word prior to being transferred to the MIRP. Upon receipt of a data sample pulse, the digital words (one for each radiometric channel) is transferred sequentially to the MIRP. The data in each word is transferred by parallel readout of the 10-bit word through 10 output data lines.

- a. **Content:** The information content of each data channel is as shown in Table 3-4A.
- b. **Digitization:** 10-bit words.
- c. **Output:** Parallel readout, 10 bits.
- d. **Output Timing:** Initiated by each data sample pulse. Timing details are as follows:
 - (1). Transfer of AVHRR/3 digitized data is accomplished by 10 parallel lines representing parallel word transfer. At $5t \pm 300$ nanoseconds after each sample time (the negative going edge of the clock which is coincident with the high or true state of the sample pulse), the AVHRR/3 transfers parallel digitized Channel 1 data to an output register and holds it there for $5t \pm 300$ nanoseconds. Data from the remaining AVHRR/3 channels is successively transferred into the output register as follows:
 - (2). Channel 2 transfer time is $10t \pm 300$ nanoseconds after sample time; data is held for $5t \pm 300$ nanoseconds. Channel 3 transfer time is $15t \pm 300$ nanoseconds; data is held for $5t \pm 300$ nanoseconds. Channel 4 transfer time is $20t \pm 300$ nanoseconds; data is held for $5t \pm 300$ nanoseconds. Channel 5 transfer time is $25t \pm 300$ nanoseconds; data is held for $5t$ minimum, $10t$ maximum ± 300 nanoseconds. Transfer of data from the AVHRR/3 output register to the spacecraft processor occurs $0.5t$ to $4.5t$ after the start of each channel output time interval.
- e. **Sample Rate:**

The number of samples taken by the MIRP as a function of scan time is as shown in Table 3-4C.
- f. **Interface Circuit:**

The interface configuration is used on each of the 10 AVHRR/3 data lines. A standard TTL gate, type SN5440, is used as the driver for each line.

Table 3-4A. AVHRR/3 Analog Channel Content

	Channel					
	1	2	3A	3B	4	5
Deep Space (Clamp)	X	X	X	X	X	X
Ramp Calibration Signal (1)	X	X	X	X	X	X
Earth Scene (Visible)	X	X	X			
Earth Scene (IR)				X	X	X
IR Target Temperature (2)				X	X	X
Cooler Patch Temp.				X	X	X
Backscan Target IR Data (3)				X	X	X

NOTES:

1. The ramp calibration signal consists of the output of a D/A generator which increases one step per revolution of the radiometer scanning system. A ramp is generated every 1,024 scans of the radiometer. The ramp voltage shall vary from -0.025 to +6.475 volts in 1,023 steps of 0.00635 volt, and shall have a precision of 10 bits.

The output A/D converter shall have a range of 0 to 6.39375 volts in 1,023 steps of 0.00625 volts. As a result, the nominal ramp calibration in the A/D output skips a step approximately once every 62 scan revolutions, and once every 62 steps of the D/A ramp generation.

Channels 1, 2, and 3A have approximately five 0-volt, 0-count values at the beginning of the calibration ramp; Channels 3B, 4, and 5 have five 0-volt, 1,023-count values at the beginning of the ramp.

Channels 1, 2, and 3A increment linearly with the scan count, except as previously noted, until the dual gain break point of 500 counts is reached. The range of ramp calibration counts is from 501 to 679 for scan lines 501 to 1,023 in Channels 1 and 2 and 501 to 577 for the same scan line count in Channel 3A.

Channels 3B, 4, and 5 ramp values increment linearly with scan line count, except as previously noted, and have 14 6.39375-volt, 0-count end-of-ramp values. Refer Table 3-4B for calibration levels.

2. The temperature of the backscan blackbody calibration target is measured using four platinum resistance temperature detectors.

The signal from each of the platinum resistance temperature detectors in the radiometer housing blackbody calibration target (IR Target Temp.) is inserted into the composite analog video signal in each channel, one signal per scan line, following the start of the space scan. The signal from the first temperature detector is inserted in the first scan line; the signal from the second temperature detector is inserted in the second scan line, etc., until all the temperature detectors have been interrogated. The scan line immediately following the line which contains the last temperature detector contains "0's" (zeros) in at least the first six significant bit locations.

3. The backscan Target IR Data is the Channel 3B, 4 and 5 IR output sampled at the time the scan mirror views the instrument backscan IR calibration target. This data, with the corresponding PRT IR Target Temperature data, provides a warm scene (nominally 288 degrees K) calibration point.

g. Pulse Level:

1. A data "1" level is +2.40 to +5.25 volts.
2. A data "0" level is 0.0 to +0.4 volts

h. Maximum Data Word Rate to MIRP: 199,680 words per second

i. Bit Position:

1. The MSB of radiometric data is located on data line 1 for each channel.
2. The LSB of radiometric data is located on data line 10 for each channel.

j. Radiometric Range:

Scene	Ch. 1, 2, 3A*	Ch. 3B, 4, 5
VIS: 100% Albedo (white) IR: Space (Cold)	+6.1V	+6.2V
VIS: Black IR: 335K (Hot)	+0.25V	+0.3V

* Visible Channels 1, 2, and 3A have dual slope gain characteristics with slope intercepts as follows:

Channel	% Albedo	Counts
1,2	0 - 25%	0 - 500
	26 - 100%	501 - 1023
3A	12.5%	0 - 500
	12.6 - 100%	501 - 1023

3.4.4 Calibration Data

- a. Line by Line Calibration: The AVHRR/3 calibration data consists of the following parameters which are inserted in each scan line:

Parameter	Channel Location	Timing
1. Space Sample	Table 3-4A	Tables 3-4C & 3-4D
2. Ramp Calibration	"	"
3. IR Target Temp. TLM	"	"
* 4. Patch Temp. TLM	"	"
5. IR Target Sample	"	"

Refer to Table 3-4B for the nominal ramp calibration voltage levels

* Note: The patch temperature telemetry will toggle when channel 3A is in use and will provide patch temperature data every other scan.

b. Simulated Calibration Signal:

The simulated calibration signal is substituted for the actual detector output upon command. The following data will appear in all channels:

	Parameter	Timing
a.	Space Sample	Tables 3-4C & 3-4D
b.	Ramp Calibration	"
c.	Simulated Earth Scan*	"
d.	Simulated Cal. Targets	"

* The simulated earth scan provides three voltage levels in a cyclical pattern on successive scan lines for each channel. This provides an effective 3-point voltage calibration check. See Table 3-4B for the nominal earth scan levels.

This command option is not normally exercised in orbit but is often used during prelaunch testing.

Table 3-4B. AVHRR/3 Voltage Calibration Levels
(All levels are nominal values)

Simulated Data	Instrument A/D Output Count (2)			
	D/A Ramp Count (1)	Chan. 1, 2	Chan. 3A	Chan. 3B, 4, 5
Space Clamp	43.0	40.0	40.0	992.0
Ramp Cal. (Lo)	0.0	-3.0 (3)	-3.0 (3)	1,035.7 (3)
Ramp Cal. (Hi)	1,023.0	679.4	576.9	-4.4 (3)
	299.0	296.0	296.0	731.7
Earth Lvl 1	555.0	517.9	507.7	471.4
Earth Lvl 2	811.0	606.2	545.5	211.2
Backscan B.B.	939.0	650.4	564.5	81.0
Dual Slope VBP (4)	500	500.0	500.0	-

NOTES:

1. 1 count = 0.00635V
2. 1 count = 0.00625V
3. Over range for A/D, actual counts are 0 or 1,023.
4. Dual slope Voltage Break Point (VBP) not included in voltage calibration, data provided for slope determination only. (Channels 1, 2, & 3A only)

3.4.5 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2-second subcom generated by the TIP will sample each Digital B telemetry point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

Word 8 of the minor frame is dedicated to the sampling of Digital B telemetry from spacecraft components.

3.4.5.1 Digital B Telemetry Points

The Digital B telemetry points provided by the AVHRR/3 are listed in Table 3-4D.

Each of the 15 Digital B telemetry points listed in Table 3-4E indicates the status of one of the 15 pairs of commands.

3.4.6 Analog Telemetry

The AVHRR/3 analog telemetry is available at the instrument interface. Three different subcoms (32, 16, 1-second) generated by the TIP are used to sample spacecraft analog telemetry. TIP minor frame words 9, 10, and 11 are dedicated to these subcoms, respectively. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

3.4.6.1 Analog Telemetry Points

The analog telemetry points provided by the AVHRR/3 are listed in Table 3-4F. The analog telemetry does not draw power from the spacecraft +28 volt Telemetry Bus. The telemetry is available when one or more of the following conditions is satisfied: 1) scan motor/telemetry is ON; 2) electronics/telemetry is ON; or 3) telemetry is locked ON. A detailed description of each telemetry point is as follows:

1. **Patch Temperature.** This telemetry point measures the output from a platinum temperature sensor located on the radiant cooler patch, which contains the IR detectors. The amplifier gain/offset is adjusted for the patch temperature range. When channel 3A (1.6 microns) is in use, this temperature point will toggle.
2. **Patch Temperature Extended.** This telemetry point measures the output from the platinum temperature sensor located on the radiant cooler patch, which contains the IR detectors. The amplifier gain/offset is adjusted for the extended temperature range of the patch.

3. **Patch Power.** This telemetry point measures the DC voltage being applied to the control heater on the radiant cooler patch, which contains the IR detectors.
4. **Radiator Temperature.** This telemetry point measures the output from the platinum temperature sensor located on the first stage (warmer stage) of the radiant cooler.
- 5 - 8. **Blackbody No's. 1, 2, 3, 4.** These telemetry points measure the output of platinum temperature sensors No's. 1 through 4, respectively, located on the blackbody calibration target.
9. **Electronics Current.** This telemetry point measures the DC current load on the +28 volt Bus (pins 1 and 2 on J3). This is directly proportional to the DC current into the power converters for the remaining electronics not including the motor power supply.
10. **Motor Current.** This telemetry point measures the DC current load on the +28 volt (Motor) Bus (pins 3 and 4 on J3). This is directly proportional to the DC current into the scan motor power supply.
11. **Earth Shield Position.** This telemetry point indicates the status of the radiant cooler earth shield as indicated.
12. **Electronics Temperature.** This telemetry point measures the output of the thermistor located inside the electronics box.
13. **Cooler Housing Temperature.** This telemetry point measures the output from a thermistor located on the radiant cooler housing.
14. **Baseplate Temperature.** This telemetry point measures the output of the thermistor located on the baseplate as shown on the Thermal Interface Drawing.
15. **Motor Housing Temperature.** This telemetry point measures the output from a thermistor located on the scan motor housing.
16. **A/D Converter Temperature.** This telemetry point measures the output of a thermistor located inside the A/D converter at the point of maximum sensitivity to heat.

17. **Detector Bias Voltage Channel 4.** This telemetry point measures a voltage directly proportional to the regulated -12 volts DC, which supplies the Channel 4 IR detector bias current.
18. **Detector Bias Voltage Channel 5.** This telemetry point measures a voltage directly proportional to the regulated -12 volts DC, which supplies the Channel 5 IR detector bias current.
19. **Blackbody Temperature, IR Channel 3.** This telemetry point measures the output of a sample-and-hold circuit which samples the IR Channel 3 analog data signal once each scan line when viewing the blackbody calibration target.
20. **Blackbody Temperature, IR Channel 4.** This telemetry point measures the output of a sample-and-hold circuit which samples the IR Channel 4 analog data signal once each scan line when viewing the blackbody calibration target.
21. **Blackbody Temperature, IR Channel 5.** This telemetry point measures the output of a sample-and-hold circuit which samples the IR Channel 5 analog data signal once each scan line when viewing the blackbody calibration target.
22. **Reference Voltage.** This telemetry point measures a DC voltage proportional to the +6.4 volt reference voltage source in the electronics.

Scan/Calibrate Operation and Timing

The AVHRR/3 scan motor rotates counterclockwise (when viewed from the motor end) at a 360 rpm rate. This causes the IF0V to scan scenes from space, through earth, to sun. Each normal scan line contains radiometric, calibration, and telemetry information.

Table 3-4C. AVHRR/3 MIRP Data Sample Intervals

AVHRR Output Information	Begin Sample Period		End Sample Period		Number of Samples Generated
	Time (Millisec)	Clock Counts	Time (Millisec)	Clock Counts	
Detector: Space View	+2.529	2,525	+2.779	2,775	10
Electronic Ramp Cal.	+3.756	3,750	+3.781	3,775	1
Detector: Earth View	+8.614	8,600	+59.895	59,800	2,048
TLM: IR Target Temp.	+65.780	65,675	+65.805	65,700	1
TLM: Patch Temp.	+66.006	65,900	+66.031	65,925	1
None	-	-	-	-	0
Detector: IR Backscan	+118.064	117,875	+118.314	118,125	10
None	-	-	-	-	0

Notes:

- (1) T_0 is the leading edge of the AVHRR line sync.
- (2) $t = 1.00160256$ microseconds = 0.9984 MHz clock period = one count
- (3) All "Times" and "Counts" are in appropriate units after T_0
- (4) AVHRR Scan Period = 1/6 second = 166.67 milliseconds
- (5) Nominal Nadir = $T_0 + 34.255$ millisecond or $T_0 + 34,200$ counts
- (6) Sample Pulse Spacing = $25t$ during sample periods (39,936 pps)

Table 3-4D. AVHRR/3 Scan/Calibrate Timing (Nominal Orbit)

a) Scan Timing

Scan Timing Units (1)

0	to	0.1	Line Sync
0.5	to	1.5	MIRP Precursor Time
		1.8	Space View Start
1.9	to	3.5	Space Sample
3.5	to	4.0	Ramp Cal
		4.13	Space End - Worse Case Early - S/C Attitude and
			Orbit
		4.8	Space End - Worse Case Early - S/C Attitude
		5.3	Space End - Nominal
		5.8	Space End - Worse Case Later - S/C Attitude
		34.2	NADIR Nominal
		62.6	Space Start - Worse Case Early - S/C Attitude
		63.1	Space Start - Nominal
		63.6	Space Start - Worse Case Late - S/C Attitude
65.6	to	65.8	IR Target Temp (2)
65.8	to	66.0	Patch Temp
		117.0	IR Cal Target - Full View Start
117.6	to	118.4	IR Cal Target Sample (3)
		119.0	IR Cal Target - Full View End
165.0	to	166.4	MIRP Precursor Time

b) Simulated Voltage Calibration Signals

4.0	to	65.6	Simulated Earth Scene
117.6	to	118.4	Simulated Cal Target

c) Auxiliary Scan Timing

1.8	to	1.9	1st Space Sample
3.4	to	3.5	2nd Space Sample
51.2	to	76.8	Back Edge Space Blanking
160.0	to	12.9	Space Window

Notes:

- (1) Scan Timing Unit (STU) = 1.001602564 milliseconds = 1000 counts
- (2) Backscan PRT
- (3) Backscan B.B. Target

Table 3-4E. AVHRR/3 Digital B Telemetry

No.	Telemetry Point Name	State		TIP		
		Logic "1"	Logic "0"	Minor Frame	Ch. #	Word 8 Bit #
1	Scan Motor/Telemetry Status	ON	OFF	20	244	8
2	Electronics/Telemetry Status	ON	OFF	20	212	7
3	Channel 1 Status	ON	OFF	21	53	2
4	Channel 2 Status	ON	OFF	21	85	3
5	Channel 3A Status	ON	OFF	21	117	4
6	Channel 3B Status	ON	OFF	21	149	3
7	Channel 4 Status	ON	OFF	20	84	3
8	Channel 5 Status	ON	OFF	21	181	6
9	Channel 3A/3B Select Status	3A	3B	26	218	7
10	Voltage Calibrate Status	ON	OFF	20	148	5
11	Cooler Heat Status	ON	OFF	20	180	6
12	Scan Motor Status	High Power	Low Power	20	116	4
13	Telemetry lock Status	Locked On	Not Locked On	21	21	1
14	Earth Shield Status	Deploy	Disable	20	20	1
15	Patch Control Status	ON	OFF	20	52	2

Table 3-4F. AVHRR/3 Analog Telemetry

No.	Telemetry Point Name	Sub-com	TIP	Channel #	Range	Resolution
			Minor Frame			
1	Patch Temperature	32	45	45	+0.2V = 86.6°K +5.0V = 115.5°K	0.1661V/Deg
2	Patch Temperature Extended	32	29	29	+0.2V = 99.4°K +5.0V = 316.0°K	0.02216V/Deg
3	Patch Power	32	5	5	+0.2V = 0.08 mW +5.0V = 50.0 mW	0.67V/mW at 32 mW out
4	Radiator Temperature	32	53	53	+0.2V = 152.6°K +5.0V = 321.0°K	0.0285V/Deg
5	Blackbody Temp 1	32	93	93	+0.2V = 5.086°C +5.0V = 44.97°C	0.1203/Deg
6	Blackbody Temp 2	32	165	165	+0.2V = 5.086°C +5.0V = 44.97°C	0.1203/Deg
7	Blackbody Temp 3	32	173	173	+0.2V = 5.086°C +5.0V = 44.97°C	0.1203/Deg
8	Blackbody Temp 4	32	181	181	+0.2V = 5.085°C +5.0V = 44.975°C	0.12033091/Deg
9	Electronics Current	16	54, 134 215, 295	372	+0.2V = 39.3 mA +5.0V = 943.4 mA	5.31 MV/mA
10	Motor Current	16	55, 135 215,295	380	+0.2V = 12 mA +5.0V = 300 mA	16.6 MV/mA
11	Earth Shield Position	32	37	37	3 levels	1.15V Fully Closed 2.99V In Between 4.99V Fully Open
12	Electronics Temperature	32	69	69	+0.2V = 39.75°C +5.0V = 10.8°C	0.1658/°C
13	Cooling Housing Temperature	32	66	66	+0.2V = 33.24°C +5.0V = -3.95°C	0.129V/°C
14	Baseplate Temp	32	77	77	+0.2V = 33.24°C +5.0V = -3.95°C	0.129V/°C
15	Motor Housing Temperature	32	85	85	+0.2V = 33.24°C +5.0V = -3.95°C	0.129V/°C
16	A/D Converter Temperature	32	189	189	+0.2V = 84.49°C +5.0V = 44.51°C	0.1200V/°C
17	Detector #4 Bias Voltage	32	21	21	+0.0V = 21.33V +5.1V = 0.78V	0.23V/V
18	Detector #5 Bias Voltage	32	247	247	+0.0V = 21.33V +5.1V = 0.78V	0.23V/V
19	Blackbody Temp. IR Channel 3B	32	197	197	+3.4V = 30.69°C +4.3V = 9.75°C	*
20	Blackbody Temp. IR Channel 4	32	205	205	+2.5V = 31.86°C +3.4V = 7.62°C	*
21	Blackbody Temp. IR Channel 5	32	252	252	TBD	TBD
22	Reference Voltage	32	13	13	Single Level at +4.8V	0.75V/V

* Exact coefficients can be obtained in the instrument Alignment and Calibration Handbook.

3.4.7 Channel 3A/3B Select Flag Operation

- a. The Channel 3A select and Channel 3B select commands from the Spacecraft are received and stored in a latching relay. A set of contacts in this relay is used to indicate its status through the digital telemetry virtually instantaneously.
- b. The other set of contacts switches a logic level on the A/D logic board, which in turn is used by the A/D sample and hold board to switch the A/D input between Channel 3A and Channel 3B. This same logic level is also used by the 3A/3B select flag circuitry.
- c. Since the command relay is synchronous, the data output will switch instantaneously between 3A or 3B, even if the scan is in the middle of a line. The select flag circuitry, however, operates differently.
- d. When Channel 3B is selected, the patch temperature data is output every scan line (during the backscan) and every other scan line when 3A is selected.
- e. When switching from 3A to 3B, the zero volt marker between lines 5 and 6 indicates that the switch occurred sometime during line #4. Therefore, there is one scan line of uncertainty when switching from 3B to 3A.
- f. When switching from 3A to 3B, the presence of patch temperature data between lines 11 and 12 indicates that the switch occurred sometime between lines 9 and 12. Therefore, there are two scan lines of uncertainty when switching from 3A to 3B.

3.5 Data Collection System (DCS-2)

3.5.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft fall into three categories; Digital A (instrument science) Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the DCS-2 are as follows:

3.5.2 Digital A Data

Digital A data is clocked into the spacecraft TIP whenever the "A₁", Data Enable Pulse is presented to the instrument. Details of the Digital A timing and interface characteristics are shown in Section 3.1.8 of the GISS.

3.5.2.1 General Requirements

Platform Data:

- a. Content: The Digital A output of the DCS-2 consists of 32 8-bit TIP words per minor frame. The DCS-2 word length is 8 bits and is formatted into messages as shown in Figure 3-5A.
 1. The DCS-2 message length varies from 16 to 44 words depending upon the number of sensors contained in the platform transmission. Each sensor data requires 4 DCS words and the number of sensors varies from a minimum of one to a maximum of eight sensors. The message length accordingly increments an additional 4 words with each additional sensor in the platform transmission.
 2. Pseudo messages are formatted as shown in Figure 3-5B. The format is the same as the platform format with the exception of the sensor data which is replaced with alternating strings of ones and zeros as shown in the figure. The pseudo-message length is a fixed sixteen words in length.
 3. Each message, whether platform or pseudo-message, is identified by Data-recovery Unit (DRU) and is transmitted completely with no interleaving of message words from other data-recovery units.
- b. Word Length: One DCS word is eight bits long.

- c. **Serial Output:** The MSB is outputted first per Figure 19 of the GHS.
- d. **Interface Circuit:** Discrete components electrically are equivalent to the standard Fast TTL to COS/MOS interface. See Figure 12 of the GHS.
- e. **Number of Minor:** Thirty-two (32) 8-bit TIP words are Frame Words: provided in each TIP minor frame
- f. **TIP Minor Frame** 18, 19, 24, 25, 28, 29, 32, 33, 40, 41, 44, 45, 52, 53, 56, 57,
Word Locations: 60, 61, 64, 65, 68, 69, 72, 73, 76, 77, 86 87, 90, 91, 94, 95

Calibration Data: The DCS-2 contains no internal calibration circuits.

3.5.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcom generated by the TIP will sample each Digital B Telemetry Point once every 3.2 seconds. The characteristic of the Digital B telemetry interface are detailed in Section 3.1.6 of the GHS.

Word 8 of the Minor Frame will be dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.5.3.1 Digital B Telemetry Points

The Digital B Telemetry Points provided by the DCS-2 are as shown in Table 3-5A.

The normal state of telemetry point 12 (Memory Overflow Status) is 'Logic "1"', which will be reported as "ZERO" in any Digital B telemetry printout. When a memory overflow occurs, the state changes to 'Logic "0"' (reported as "ONE" at the beginning of the next TIP major frame, and returns to 'Logic "1"' (reported as "ZERO") at the conclusion of that major frame. When the DCS is turned ON, the state will be 'Logic "0"' until the beginning of the next TIP major frame, at which time it will change to 'Logic "1"'. If memory overflow occurs simultaneously with the TIP major frame pulse, no change in telemetry will occur.

3.5.4 Analog Telemetry

The Analog Telemetry is available at the instrument interface at all times. Three different subcoms (32, 16, and 1-sec) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6 of the GISS.

Table 3-5A. DCS-2 Digital B Telemetry

No.	Telemetry Point Name	Logic State (1)		Minor Frame	Chan #	Bit
		"0"	"1"			
1	DCS Relay A Status	ON	OFF	27	251	8
2	DCS Relay B Status	ON	OFF	28	28	1
3	DRU 1	ON	OFF	28	60	2
4	DRU 2	ON	OFF	28	92	3
5	DRU 3	ON	OFF	28	124	4
6	DRU 4	ON	OFF	28	156	5
7	DRU 5	ON	OFF	28	188	6
8	DRU 6	ON	OFF	28	220	7
9	DRU 7	ON	OFF	25	185	6
10	DRU 8	ON	OFF	25	217	7
11	Memory Overflow	One	Zero	28	252	8
12	DCS Time Code (MSB)(2)	1	0	29	29	1
13	Pseudo Message Status	ENABLE	DISABLE	26	186	6

- (1) Logic "0" or "High Voltage" state (5+/- .7V) is ON, all Digital B telemetry reads Logic "1" when DCS-2 is OFF
- (2) MSB - TBD

3.5.4.1 Analog Telemetry Points

The analog telemetry points provided by the DCS are as shown in Table 3-5B. Descriptions of each telemetry point are given below.

- (1) RPU Temperature: Monitor RPU temperature from -20 to +80 degrees C.
- (2) SPU-A Temperature: Monitor SPU-A temperature from -20 to +80 degrees C.
- (3) SPU-B Temperature: Monitor SPU-B temperature from -20 to +80 degrees C.

- (4) Converter Voltage +5V: Monitor the +5 volts DCS power line voltage.
- (5) Converter Voltage +12V: Monitor the +12V DCS power line voltage.
- (6) Converter Voltage -5.2V Monitor the -5.2V DCS power line voltage.
- (7) Converter Voltage -12V: Monitor the -12V DCS power line voltage.
- (8) Converter Temperature: Monitor the power converter temperature.
- (9) USO Temperature: Monitor the USO temperature from -10 to +85 degrees C.
- (10) USO Thermal Regulation Voltage: Monitor USO voltage regulation which controls oven temperature.

Table 3-5B. DCS-2 Analog Telemetry

No.	Telemetry Point Name	Sub com	Minor Frame	Ch #	Range
1	RPU-Temperature	32	175	175	-20 to +80°C (1)
2	SPU-A-Temperature	32	167	167	-20 to +80°C (1)
3	SPU-B-Temperature	32	47	47	-20 to +80°C (1)
4	Converter-Voltage +5 V	32	238	238	0 to 5.565 V (2)
5	Converter-Voltage +12 V	32	15	15	0 to 14.0V (3)
6	Converter-Voltage -5.2 V	32	31	31	0 to 10.2 V (4)
7	Converter-Voltage -12 V	32	23	23	0 to 14.3V (5)
8	Converter-Temperature	32	39	39	-20 to 80°C (1)
9	USO Oven Temperature	32	175	175	-10 to +85°C (6)
10	USO Thermal Regulation	32	71	71	0 to 5.1V (7)

Note: Table 3-5B telemetry transfer functions are:

- (1) TBD
- (2) $1.113 * V_{tm}$
- (3) $2.7533 * V_{tm}$
- (4) $2.2288 * V_{tm} - 1.2288$
- (5) $3.2263 * V_{tm} - 2.2263$
- (6) $137.7396 - 21.8069 * V_{tm}$
- (7) $1 * V_{tm}$

3.5.4.2 Exceptions.

The instrument output signals shall conform to Paragraphs 3.1.6 and 3.1.8 of the GLIS. There are no exceptions to the above specification.

Bit	0	1	2	3	4	5	6	7
Word 0	D Synchronization Word						6	
1	0 Sync.		Pseudo		DRU Number			
2	Sensor Number		Parity		Level 3/6			
3	Level 3/6		Time	5/20	20 MS per bit			
4			Time	8/20				
5			Time	7/20	LSB		Parity	
6			"ID"	8/20				
7			"ID"	8/20				
8	"ID"		8/20	0	0	0	0	
9	Sensor Number		1					
			:					
			:	4 to 4 x 8 Sensors				
			:					
N-2	MSB		Doppler		8/23			
N-1			Doppler		8/23			
N			Doppler		7/23		LSB	Parity

Figure 3-5A. DCS-2 Message Format

Bit	0	1	2	3	4	5	6	7	
Word 0	D Synchronization Word				6				
1	0 Sync.				1	DRU Number			
2	0 0 0 0				Parity	Level 3/6			
3	Level 3/6			Time	5/20	20 MS per bit			
4				Time	8/20				
5				Time	7/20	LSB		Parity	
6	Word 6								
7	Word 7								
8	Word 8								
9	Word 9								
10	Word 10								
11	Word 11					4 to 4 x 8	Sensors		
12	Word 12								
13	MSB		Doppler	8/23					
14			Doppler	8/23					
15			Doppler	7/23					
				LSB					Parity
	Word Content:		Words 6, 7, 8:				1111 0000		
			Words 9, 10, 11, 12:				0000 1111		

Figure 3-5B. DCS-2 Pseudo-Message Format

3.6 High Resolution Infrared Radiation Sounder (HIRS/3)

3.6.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft fall into three categories; Digital A (radiometric) Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the HIRS/3 are detailed below.

3.6.2 Digital A Data

Digital A data is clocked into the spacecraft TIP whenever the "A₁" Data Enable Pulse is presented to the instrument. Details of the Digital A timing and interface characteristics are shown in Section 3.1.8 of the GISS.

3.6.2.1 General Requirements

Content of Digital A

A full set of HIRS/3 operational data, including command status monitors, housekeeping information and radiance data of the 20 channels, is contained in the Digital A output. The HIRS/3 data repeats every 6.4 seconds as described below. The 6.4 second period contains 64 elements.

The earth scan sequence and the calibration cycle are shown in Figure 3-6A.

a. Element Definition

Digital A output is divided into "elements" of 288 bits. One element is phased to fit into a TIP minor frame. The TIP will allocate 36 8-bit words to accommodate the HIRS/3 element. These TIP words will be grouped by two in fixed location throughout the 100 millisecond minor frame.

b. Element Formats

Sixty-four (64) elements make up each scan. The formats for the elements repeat every 6.4 second and correspond to the particular parts of the scan. Element number 0 through 55 are earth scan data (target data during the calibration sequence). Elements 56 through 63 are associated with retrace or when the mirror is slewing between positions. The elements are divided as follows:

1. Bits 1-26

Two 13 bit words have the same function in all 64 elements. The function assembled in these words are as follows:

<u>Word 1</u>	<u>Function</u>	<u>Range (Decimal)</u>
1-8	Scan Encoder Position	0 to 199
9-13	Electronic Cal Level Indicator	0 to 31

<u>Word 2</u>	<u>Function</u>	<u>Range (Decimal)</u>
1-6	Channel 1 Period Monitor	0 to 63
7-12	Element Number	0 to 63
13	Filter Sync Designator	NA

2. Bits 27-286

This group of bits are divided into 20 13-bit words. The word functions are dependent on element number. These functions are given in Table 3-6A. Except for the two status words in Element 63 all words are quantity where bit 1 is the sign bit and bits 2 through 13 are amplitude (0 to 4095). Bit 2 is the most significant bit (MSB) of quantity. The sign bit is:

logic "1" +
logic "0" -

3. Bits 287 & 288

In the same manner as for bits 1 through 26 these two bits have the same function in all 64 elements.

Bit 287 Valid Data Bit

logic "1" Valid Data
logic "0" Ignore Radiometric Data

Bit 288 Odd bit parity

Word Length. One HIRS/3 word is contained in two contiguous 8 bit TIP words. These two words occur in 1.899 msec.

Number of Minor Frame Words. Eighteen (18) pairs, each consisting of two Minor Frames TIP words, are required per minor frame. These eighteen words make up one HIRS/3 Element.

Serial Output. The Digital A output is a serial output of 288 bits per element. The first bit (Bit 1) occurs in the MSB, as defined in the GLIS, Figure 19, of TIP word 14.

Standard Interface. The Digital A output is a standard fast CMOS to CMOS interface.

Interface Logic Elements

CMOS CD4041AK.

Restriction Placed on Minor Frame Word Location: NONE

Table 3-6A. HIRS/3 Digital A Radiometric and Housekeeping Functions (1 of 4)

Element No	Bit No	Function	Remarks
0-55	27- 39	Radiometric Channel No 1 (668.5 cm^{-1})	0 counts radiance from scene equal radiance from Filter Wheel (FW). Minus (-) values are colder than FW. Plus (+) values are warmer than FW.
	40-52	Radiometric Channel No 17 (2,420 cm^{-1})	0 counts offset from FW radiance. Plus and minus are hot and cooler than offset.
	53-65	Radiometric Channel 2 (680 cm^{-1})	No offset.
	66-78	Radiometric Channel 3 (690 cm^{-1})	No offset.
	79-91	Radiometric Channel 13 (2, 188 cm^{-1})	Offset.
	92-104	Radiometric Channel 4 (703 cm^{-1})	No offset.
	105-117	Radiometric Channel 18 (2515 cm^{-1})	Offset.
	118-130	Radiometric Channel 11 (1365 cm^{-1})	No offset.
	131-143	Radiometric Channel 19 (2660 cm^{-1})	Offset.
	144-156	Radiometric Channel 7 (749 cm^{-1})	No offset.
	157-169	Radiometric Channel 8 (900 cm^{-1})	No offset.
	170-182	Radiometric Channel 20 Visible (14,500 cm^{-1} 689 nm)	Black is minus. White is plus.
	183-195	Radiometric Channel 10 (802 cm^{-1})	No offset.
	196-208	Radiometric Channel 14 (2,210 cm^{-1})	Offset.
	209-221	Radiometric Channel 6 (749 cm^{-1})	No offset.
	222-234	Radiometric Channel 5 (716 cm^{-1})	No offset.
	235-247	Radiometric Channel 15 (2,235 cm^{-1})	Offset.

Table 3-6A. HIRS/3 Digital A Radiometric and Housekeeping Functions (2 of 4)

55 (cont)	248-260	Radiometric Channel 12 (1,533 cm ⁻¹)	No offset.
	261-273	Radiometric Channel 16 (2,245 cm ⁻¹)	Offset.
	274-286	Radiometric Channel 9 (1,030 cm ⁻¹)	Offset.
56	27-286	Positive Electronics Calibration applied to 20 radiometric channels.	Calibration level advances one of the 32 equal level steps on successive scans. The off-set and gain of each channel will influence the amplitude of the signal. The calibration level applied to the (continued) electronic channels is indicated by bits 9 through 13 of the Element.
57	27-286	Negative Electronics Calibration applied to 20 radiometric channels	
58	27- 91	Internal Warm Target Temperature Sensor #1	Value repeated 5 times. Range 273 to 333°K.
	92-156	Temperature Sensor #2	
	157-221	Temperature Sensor #3	
	222-286	Temperature Sensor #4	
59	27- 91	Internal Cold Target Temperature Sensor #1	Value repeated 5 times. Range 243 to 303°K.
	92-156	Temperature Sensor #2	
	157-221	Temperature Sensor #3	
	222-286	Temperature Sensor #4	
60	27- 91	Filter Wheel Housing Temperature Sensor #1	Value repeated 5 times. Range 273 to 333°K.
	92-156	Temperature Sensor #2	
	157-221	Temperature Sensor #3	
	222-286	Temperature Sensor #4	
61	27- 91	Patch Temperature Expanded Scale	Value repeated 5 times. Range 90 to 150°K.
	92-156	First Stage Radiator Temperature Sensor	Value repeated 5 times. Range 150°K to 320°K.

Table 3-6A. HIRS/3 Digital A Radiometric and Housekeeping Functions (3 of 4)

61 (cont)	157-221	Filter Wheel Housing Heater Current	Value repeated 5 times 0 to 500 ma.
	222-286	Electronic Calibration Digital to Analog Converter	Value repeated 5 times. Range volts 0 to 4V.
62	27- 39	Scan Mirror Temperature	Range 260 to 320 degrees K
	40-52	Primary Telescope Temperature	Range 260 to 320 degrees K
	53-65	Secondary Telescope Temperature	Range 260 to 320 degrees K
	66-78	HIRS/3 Baseplate Temperature	Range 260 to 320 degrees K
	79-91	HIRS/3 Electronics Temperature	Range 260 to 320 degrees K
	92-104	Patch Temperature-Full Range	Range 90 to 320 degrees K
	105-117	Scan Motor Temperature	Range 260 to 320 degrees K
	118-130	Filter Wheel Motor Temperature	Range 260 to 320 degrees K
	131-143	Cooler Housing Temperature	Range 260 to 320 degrees K
	144-156	Patch Control Power	Range 0 - 80 mw
	157-169	Scan Motor Current	Range 0.65 to 1.0
	170-182	Filter Motor Current	Range 100 to 300 ma
	183-195	+15 VDC	Range $15 \pm 0.2V$
	196-208	-15 VDC	Range $-15 \pm 0.2V$
	209-221	+7.5 VDC	Range $+7.5 \pm 0.05V$
	222-234	-7.5 VDC	Range $-7.5 \pm 0.05V$
	235-247	+10 VDC	Range $10 \pm 0.2V$
	248-260	+5 VDC	Range $5 \pm 0.2V$
	261-273	Analog Ground	Range 1 count
	274-286	Analog Ground	Range ± 1 count
63	27- 39	Line Counter (Gives the number of lines from the last auto calibration sequence)	0 to 8191 (There is no sign bit used in the line counter). Reset to 0 count is only when counter overflows.

Table 3-6A. HIRS/3 Digital A Radiometric and Housekeeping Functions (4 of 4)

63 (cont)	40-52	First Status Word	First 5 bits are instrument serial number (no sign bit). The remaining bits indicate status as shown in Table 3-6B.
	53-65	2nd Status Word	First 5 bits are zero fill. The remaining bits indicate status as shown in Table 3-6B.
	66-78	Data Verification Binary Code	Binary Code is: (1 1 1 1 0 0 1 0 0 0 1 1) Equivalent Base 10 value + 3875
	79-91		Base 10 value + 1443
	92-104		-1522
	105-117		-1882
	118-130		-1631
	131-143		-1141
	144-156		+1125
	157-169		+3655
	170-182		-2886
	183-195		-3044
	196-208		-3764
	209-221		-3262
	222-234		-2283
	235-247		-2251
	248-260		+3214
	261-273		+1676
	274-286		+1992

Table 3-6B. HIRS/3 Digital A Status Telemetry

Element No	Bit No	Function	Logic State
63		First Status Word	
	45	Instrument ON/OFF	ON = 1
	46	Scan Motor ON/OFF	ON = 0
	47	Filter Wheel ON/OFF	ON = 0
	48	Electronics ON/OFF	ON = 1
	49	Cooler Heat ON/OFF	ON = 0
	50	Internal Warm Tgt. Pos	True = 0
	51	Internal Cold Tgt. Pos	True = 0
	52	Space Pos.	True = 0
		Second Status Word	
	58	NADIR Pos.	True = 0
	59	Calibration Enable/Disable	Enabled = 0
	60	Cooler Door Release Enable/Disable	Enabled = 0
	61	Cooler Door Open	Yes = 1
	62	Cooler Door Closed	Yes = 1
	63	Filter Housing Heat ON/OFF	ON = 0
	64	Patch Temperature Control ON/OFF	ON = 0
	65	Filter Motor Power HIGH	Normal = 1

3.6.3 Digital B Telemetry

General. The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcom generated by the TIP samples each Digital B Telemetry Point once every 3.2 seconds. The characteristics for the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

Parts of Minor Frames 1, 4, 22, 29, 30 and 31 are used for the sampling of Digital B telemetry from all spacecraft components.

3.6.3.1 Digital B Telemetry Points

The Digital B Telemetry Points provided by the HIRS/3 are shown in Table 3-6C.

Table 3-6C. HIRS/3 Digital B Telemetry

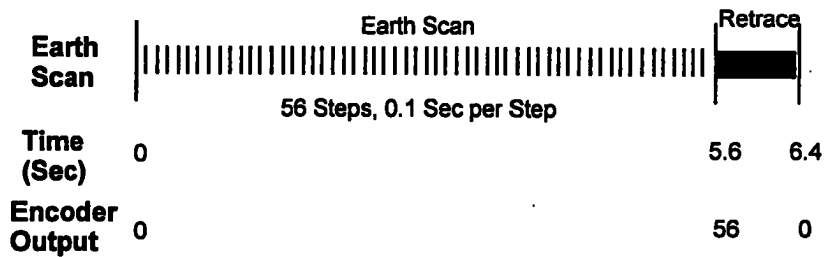
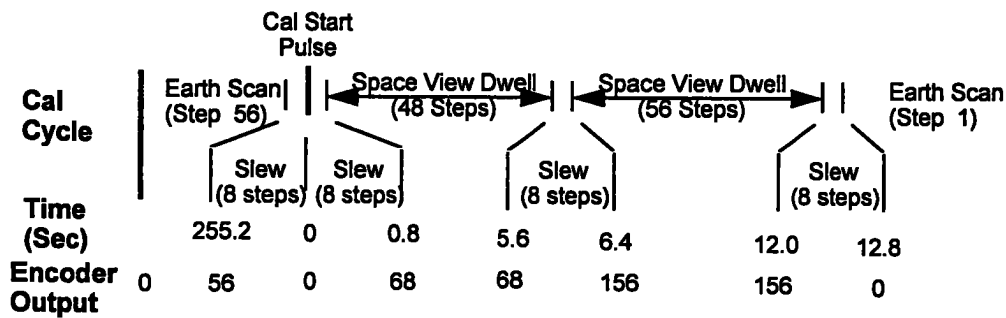
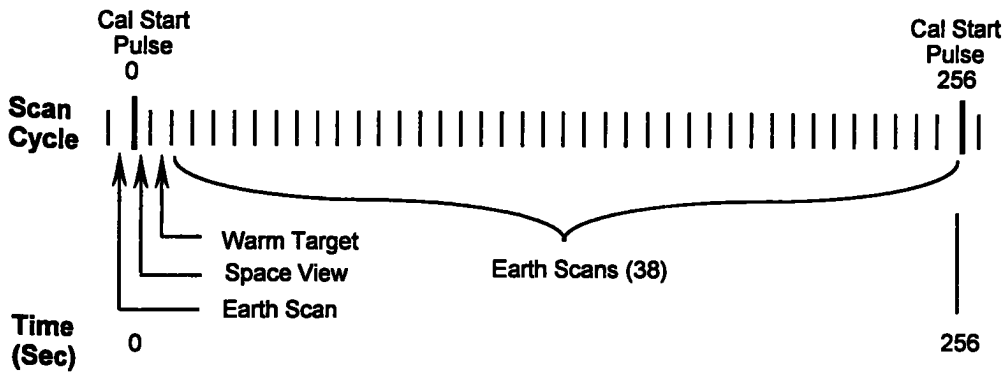
No.	Telemetry Point Name	Digital "B" Channel No.	State	
			Logic "1" (0 V)	Logic "0" (+5 V)
1	Instrument Power	22	On	Off
2	Electronics Power	30	On	Off
3	Filter Motor Power	54	On	Off
4	Scan Motor Power	61	On	Off
5	Cooler Heater	68	On	Off
6	Filter Housing Heater	95	On	Off
7	Cooler Door Release	118	Enabled	Disabled
8	Cooler Window Heater	125	Off	On
9	Go to NADIR Position	128	Yes (Initiated)	No
10	Calibration Sequence	150	Enabled	Disabled
11	Cooler Door Closed	157	No	Yes
12	Cooler Door Fully Open	165	No	Yes
13	Filter Motor Power Level	189	High	Normal
14	Patch Temperature Controller	215	On	Off

3.6.4 Analog Telemetry

General. The Analog Telemetry is available at the instrument interface at all times. Three different subcoms (32, 16, and 1-second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

3.6.4.1 Analog Telemetry Points

Sixteen words from the 16 and 32 second subcoms are dedicated to HIRS/3 analog telemetry. The analog telemetry points provided by HIRS/3 are shown in Table 3-6D.



Note: No cold target dwell for HIRS/3.

Figure 3-6A. HIRS/3 Scan Step Sequence with Calibration Cycle

Table 3-6D. HIRS/3 Analog Telemetry

No.	Telemetry Point Name	Subcom Name	Channel No. /FF No.	Range	Resolution
1	Radiator Temperature	32 AN	6	150-320°K	0.6°K
2	Baseplate Temperature (Powered by +28V Analog Bus)	32 AN	14	260-320°K	0.7°K
3	Electronics Temperature	32 AN	22	260-320°K	
4	Patch Temperature	32 AN	231	90-320°K	
5	Filter Housing Controller Current	16 AN	285/9 374/9	0-330 mA	
6	Scan Motor Temperature (Powered by +28V Analog Bus)	32 AN	239	260-320°K	
7	Filter Wheel Motor Temp.	32 AN	246	260-320°K	
8	+5 VDC Monitor	16 AN	301/82	5 ± 0.2V	
9	+10 VDC TLM DC/DC Conv.	16 AN	334/85	10 ± 0.2V	
10	+7.5 VDC TLM DC/DC Conv.	16 AN	342/86	7.5 ± 0.2V	
11	-7.5 VDC TLM DC/DC Conv.	16 AN	359/141	-7.5 ± 0.2V	
12	+15 VDC Monitor	16 AN	366/88	15 ± 0.2V	
13	-15 VDC Monitor	16 AN	271/84	-15 ± 0.2V	
14	Filter Wheel Motor Current	16 AN	261/29 262/29	100-300 mA	2 mA
15	Scan Motor Current	32 AN	245	0.65 to 1.0 A	
16	Patch Controller Power	32 AN	255	0 to 80 mW	

3.7 Search and Rescue Processor (SARP-2)

3.7.1 Instrument Output Signals

The instrument outputs the following three categories of output signals: 1) Digital (Platform) Data to SARR, 2) Digital B Telemetry, and 3) Analog Telemetry. The specific signals supplied by the SARP are as follows.

3.7.2 Digital Data

Data on the SARP-2 output line is Bi-phase L, code Manchester at a data bit rate = $F_{uso}/2160$, - 2408.89 Hz. A bit "1" in the NRZ gives a 10V down to 0 transition in the biphasic (in the middle of the bit period). A bit "0" gives a 0 to 10V up transition. The output level on the digital data line when the SARP is off and bus power is on is a logic "0" (+10V).

3.7.2.1 General Requirements

SARP Data

- a. **Data Format.** Instrument output data is comprised of 24-bit words; words are organized into messages containing eight words. Messages are either "short" or "long" as shown in Figures 3-7A and 3-7B respectively, depending on the total number of data bits to be transmitted or are in pseudo-message format as shown in Figure 3-7C. All messages are serial output and begin with bit 23 (24th bit) as the first bit.
- b. **Frame Format.** Instrument output data is additionally organized into frames comprised of twenty-five 24-bit words (600 bits); a frame sync word followed by three complete eight word messages. Note in Figure 3-7A that a short message contains a "0" (zero) word to complete the message. The frame format is as shown in Figure 3-7D.
- c. **Memory data.** The instrument memory has a capacity of 393,216 bits or 2,048 messages. The memory operates in a continuous "circular" Last In First Out (LIFO) read-out mode.

When memory is ON, incoming messages received into the memory unit are simultaneously transmitted directly (real-time messages) and stored in the memory for subsequent transmission (playback messages). Playback messages always are transmitted on a LIFO basis. When any one of the playback (Read Memory) modes is active, there is continuous transmission of stored messages (LIFO), one immediately following another. Playback message transmission is interrupted if a new message becomes available for real-time transmission, but only upon

completion of transmission of the current playback message. Refer to Figure 3-7D for the frame format.

Following real-time transmission (and storage) of the new message, playback transmission resumes where it left off. If the memory is filled, the new message overwrites the oldest stored message.

If none of the playback modes is active and no messages are available for real-time transmission, filler or "zero" words are transmitted. The zero word consists of "0" for each of the first 23 bits and "1" for the 24th (000001 in hexadecimal).

If any one of the Read commands is received by the SARP-2 during the transmission of a message, transmission of that message is completed, and then the mode indicated by the Read command is implemented (with playback starting with the most recent message stored in the memory).

The order of priority in selection of the next message to be transmitted is as follows:

1. Transmit frame sync word (42BB1F) if this is the first word of a frame.
 2. Transmit the most recently stored message if a Read command has been received but not implemented.
 3. Transmit a real-time message which has not been transmitted.
 4. Transmit the next most recently stored playback message.
 5. Transmit the most recently stored message if Read continuously mode is active and if the oldest playback message has just been transmitted. A zero word will precede resumption of playback.
 6. Transmit the zero word (000001).
- d. SARP-2 Data Handling in Spacecraft.

SARP-2 output is transmitted as continuous 2409* bps Bi-Phase Data to the SARR where it is transmitted to the ground station as modulation of the SARR output.

* The exact value of the data rate is: $F_{uso}/2160 = 2408.89$

Calibration Data. The SARP-2 contains no internal calibration circuits.

3.7.3 Digital B Telemetry

General. The Digital B one-bit status telemetry is available at the instrument interface at all times when the SARP is on. The 3.2 second subcom generated by the TIP samples each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6 of the GUIS.

Words 8 & 12 of the TIP Minor Frame are dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.7.3.1 Digital B Telemetry Points

The Digital B Telemetry Points provided by the SARP-2 are as shown in Table 3-7A. The telemetry points are as follows:

Telemetry points #1 through #5 and telemetry point #8 indicate the ON/OFF status of the instrument functions.

Telemetry point #6 changes logic level each time the Time word (see Figure 3-7A) reaches all "1's" and reinitializes at zero. The MSB changes every 44 hours, 29 minutes, 48 seconds*. This telemetry point is normally, but not necessarily always, reset to logic "0" following instrument turn on.

Telemetry point #7 indicates the ENABLE/DISABLE status of the pseudo-message processing.

Telemetry points #9, 10 and 11 indicate the most recent selection of Read mode; thus only one can be ON at any time. All three are OFF immediately following a memory ON (or OFF) command, and subsequent transmission of any of the three Read commands causes the corresponding point to read ON and the other two points to read OFF. In the case of the Single Shot commands, the telemetry points continue to read ON, even though the reading activity has been completed, until another command is sent.

* $44 \text{ h } 29 \text{ m } 48 \text{ s} = (2^{23}) \times (99360/\text{Fuso}) \approx 20 \text{ ms}$; where $\text{Fuso} = 5.203205 \text{ MHz}$.

Telemetry points #12 through #14 indicate the RPU bandwidth selected. The bandwidths are:

- a. Receiver Bandwidth 1 - 406.010-406.090 MHz
- b. Receiver Bandwidth 2 - 406.010-406.050 MHz
- c. Receiver Bandwidth 3 - 406.010-406.047 MHz

Table 3-7A. SARP-2 Digital B Telemetry

No.	Telemetry Point Name	Logic State *		Minor Frame	Ch. #	Bit #
		"0"	"1"			
1	SARP Relay A Status	ON	OFF	2	258	1
2	SARP Relay B Status	ON	OFF	2	282	2
3	DRU 1	ON	OFF	2	306	3
4	DRU 2	ON	OFF	2	330	4
5	DRU 3	ON	OFF	18	274	1
6	SARP Time Code (MSB)	—	—	8	264	1
7	Pseudo-M	ENABLE	DISABLE	5	333	4
8	Memory ON/OFF	ON	OFF	6	334	4
9	Read continuously	ON	OFF	22	326	3
10	Read single shot	ON	OFF	14	342	4
11	Read/erase single shot	ON	OFF	23	351	4
12	Receiver Bandwidth 1	ENABLE	DISABLE	18	298	2
13	Receiver Bandwidth 2	ENABLE	DISABLE	18	322	3
14	Receiver Bandwidth 3	ENABLE	DISABLE	18	346	4
* Logic "0" or "High Voltage" state ($5 \pm .7V$) is "ON"; all Digital B telemetry reads logic "1" when the SARP is OFF.						

3.7.4 Analog Telemetry

General. The Analog Telemetry is available at the instrument interface at all times. Three different subcoms (32, 16, and 1-second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6 of the GHS.

3.7.4.1 Analog Telemetry Points

The analog telemetry points provided by the SARP are as shown in Table 3-7B. Descriptions of the telemetry points are given below.

a. RPU - Temperature

1. Function: To monitor Receiving Unit temperature from - 10°C to +50°C.

b. SPU Temperature

1. Function: To monitor the signal 2 processing unit temperature from -10°C to +50°C.

c. Converter Voltage +5V

d. Converter Voltage +12V

1. Function: To monitor the +12V power line voltage.

e. Converter Voltage -5.2V

1. Function: To monitor the -5.2V power line voltage.

f. Converter Voltage -12V.

1. To monitor the -12V power line voltage.

g. Converter Temperature

1. Function: To monitor the power converter temperature.
2. Position: On the power transistor's radiator.

h. USO Temperature

1. Function: To monitor USO temperature from 0 to +100°C.
2. Position: Inside the internal Dewar flask near the quartz oscillator.

i. USO Thermal Regulation Voltage

1. Function: To monitor USO regulation voltage which controls oven temperature.

The instrument output signals conform to Sections 3.1.6 and 3.1.8 of the GIIIS.

3.7.4.2 Exceptions:

None.

Table 3-7B. SARP-2 Analog Telemetry

No.	Telemetry Point Name	Sub Com	Minor Frame	Ch#	Range
1	RPU Temperature	A16A	0, 160	384	-20 to 80°C (1)
2	SPU Temperature	A16A	58, 218	442	-20 to 80°C (1)
3	Converter Voltage +5V	A16A	91, 251	475	0 to 5.565V (2)
4	Converter Voltage +12V	A16A	98, 258	482	0 to 14V (3)
5	Converter Voltage -5.2V	A16A	11, 171	395	0 to 10. 2V (4)
6	Converter Voltage -12V	A16A	122, 282	506	0 to 14.3V (5)
7	Converter Temperature	A16A	74, 234	458	0 to 80°C (1)
8	USO Temperature	A16A	80, 240	464	-10 to 85°C (1)
9	USO Thermal Regulation	A16A	50, 210	434	0 to 5.1V (7)

NOTE

Telemetry transfer functions are:

(1) TBD

(2) $1.113 * V_{tm}$

(3) $2.7533 * V_{tm}$

(4) $2.2288 * V_{tm} - 1.2288$

(5) $3.2263 * V_{tm} - 2.2263$

(6) $134.4396 - 21.8069 * V_{tm}$

(7) $1 * V_{tm}$

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0	Message Sync D60 (Hex)											PSE UDO	DRU Num		Long Short	MR Msg	RT/ PB	Received Level						
1	Time (Binary Value - 20 Milliseconds Per Bit)																						P	
2	24 Data Bits																							
3	24 Data Bits																							
4	24 Data Bits																							
5	15 Data Bits																							
6	MSB											Doppler										LSB	P	
7	Zero Word																							

Figure 3-7A. SARP-2 Message Format - Short Message

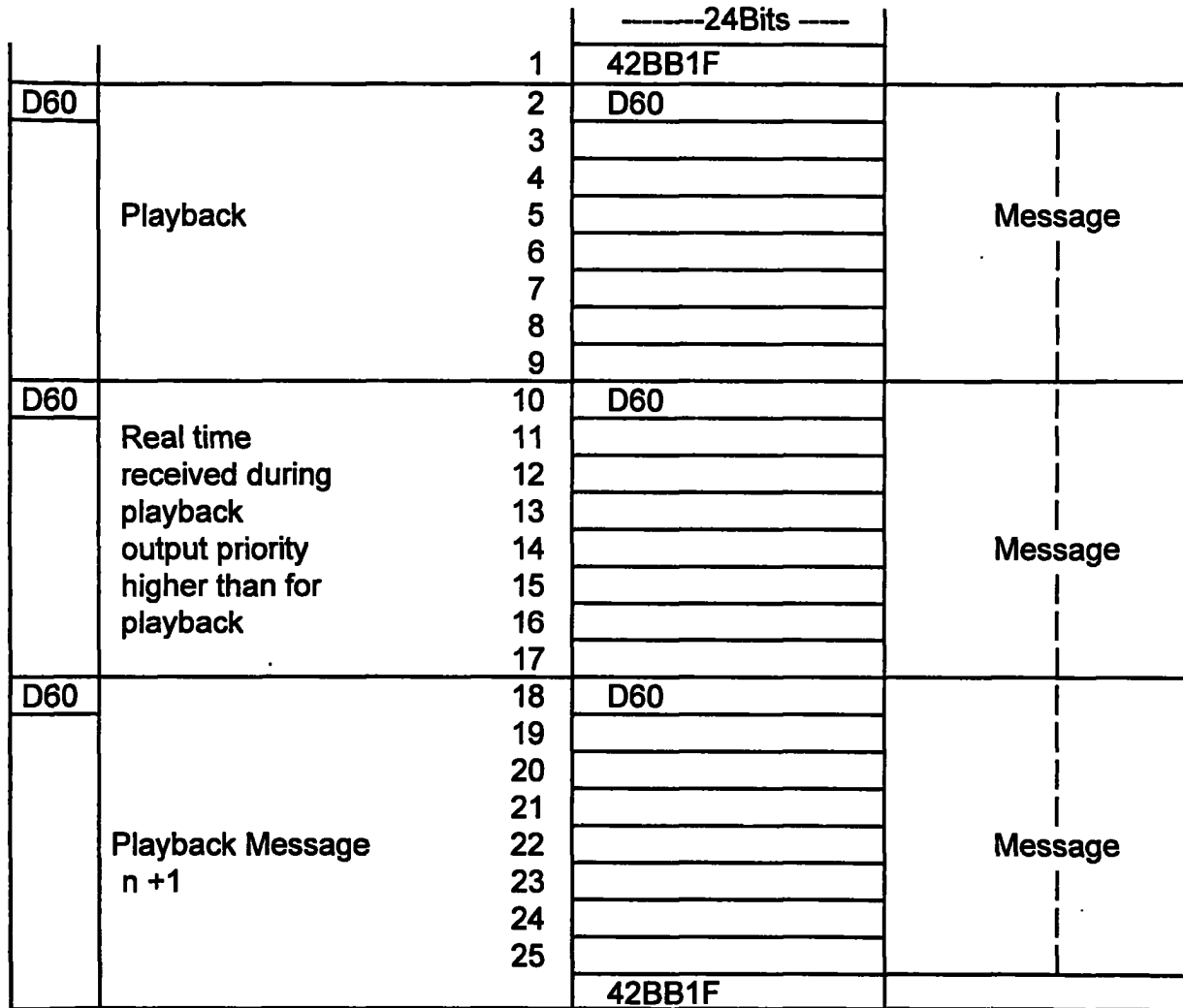
Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0	Message Sync D60 (Hex)											PSE UDO	DRU Num		Long Short	MR Msg	RT/ PB	Received Level						
1	Time (Binary Value - 20 Milliseconds Per Bit)																						P	
2	24 Data Bits																							
3	24 Data Bits																							
4	24 Data Bits																							
5	24 Data Bits																							
6	MSB											24 Data Bits										LSB		P
7	Zero Word																							

Figure 3-7B. SARP-2 Message Format - Long Message

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
0	Message Sync D60 (Hex)												1	DRU Num		0	MR Msg	RT/ PB	Received Level						
1	Time (Binary Value - 20 Milliseconds Per Bit)																						P		
2	Byte 00											Byte 01										Byte 02			
3	Byte 03											Byte 04										Byte 05			
4	Byte 06											Byte 07										Byte 08			
5	Byte 09											Byte 10										Byte 11			
6	MSB											Doppler										LSB		P	
7	Don't Care Word																								

Figure 3-7C. SARP-2 Message Format - Pseudo Message

Figure 3-7D. SARP-2 Frame Format



3.8 Search and Rescue Repeater (SARR)

3.8.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft fall into two categories: Digital B Telemetry and Analog Telemetry. The specific signals supplied by the SARR are detailed in the following subsections.

3.8.2 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2-second subcoms generated by the TIP samples each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GHS.

Words 8 and 12 of the Minor Frame are dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.8.2.1 Digital B Telemetry Points

Four digital B Telemetry Points are required by the SARR. The Digital B Telemetry Points provided by the SARR are shown in Table 3-8A. A description of each telemetry point is provided below.

SARR 121.5 MHz RF Redundancy Switch. This point reports which of the two redundant 121.5 MHz receivers is connected to SARR J8, the interface with the 121.5 MHz RF filter. This telemetry point provides valid data in all SARR modes.

SARR 243 MHz RF Redundancy Switch. This point reports which of the two redundant 243 MHz receivers is connected to SARR J9, the interface with the 243-MHz RF filter. This telemetry point provides valid data in all SARR modes.

SARR 406.05 MHz RF Redundancy Switch. This point reports which of the two redundant 406.05 MHz receivers is connected to SARR J10, the interface with the 406.05-MHz RF filter, RFF-3 (1). This telemetry point provides valid data in all SARR modes.

SARR Tx Output RF Redundancy Switch. This point reports which of the two redundant transmitters is connected to SARR J11, the interface with the SAR L-band Antenna (SLA). This telemetry point provides valid data in all SARR modes.

3.8.3 Analog Telemetry

The Analog Telemetry is available at the instrument interface at all times during which the instrument is on. Three different subcom types (32, 16, and 1 seconds) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GISS.

3.8.3.1 Analog Telemetry Points

The Analog Telemetry points provided by the SARR are shown in Table 3-8B. Descriptions of each telemetry point are detailed below. Twenty-two Analog Telemetry channels are required by the SARR to monitor the health of the instrument.

- a. SARR Tx A RF Driver Current. When Transmitter "A" is ON, this telemetry voltage is an analog of the DC current drawn by the transmitter "A" RF driver amplifier from the Transmitter A regulated power supply. When Transmitter A is OFF, this telemetry voltage is 0 ± 0.5 volts.
- b. SARR Tx B RF Driver Current. The description in paragraph (a.) above applies, substituting "B" for "A".
- c. SARR PTC 28 Volt Input Monitor. This telemetry voltage is an analog of the +28 Volt Main Bus voltage at the input to either or both PTCs, independent of SARR ON/OFF status.
- d. SARR PTC A 16 Volt Output Monitor. This telemetry voltage is an analog of the PTC "A" DC/DC converter output voltage, independent of SARR ON/OFF status.
- e. SARR PTC B 16 Volt Output Monitor. The description in paragraph (c.) above applies, substituting "B" for "A".
- f. SARR 121.5 MHz Rx A AGC Volts. When 121.5 MHz Receiver "A" is powered, this telemetry voltage is an analog of the gain control voltage to the 121.5 MHz Receiver "A" I.F. amplifiers. The analog relationship is independent of whether the receiver is in automatic-gain-control mode or in fixed-gain mode. When 121.5 MHz Receiver "A" is unpowered, this telemetry voltage is 0 ± 0.5 volts.
- g. SARR 121.5 MHz Rx B AGC Volts. The description in paragraph (f.) above applies, substituting "B" for "A".
- h. SARR 243 MHz Rx A AGC Volts. The description in paragraph (f.) above applies, substituting "243" for "121.5".

- i. SARR 243 MHz Rx B AGC Volts. The description in paragraph (h.) above applies, substituting "B" for "A".
- j. SARR 406.05 MHz Rx A AGC Volts. If the SARR contains a functional receiver in the 406.05 MHz Receiver A position, the description in paragraph (f.) applies, substituting "406.05" for "121.5". If the SARR contains a dummy in the 406.05 MHz Receiver "A" position, this telemetry voltage is 0 ± 0.5 volts.
- k. SARR 406.05 MHz Rx B AGC Volts. The description in paragraph (j.) above applies, substituting "B" for "A".
- l. SARR Tx A Temperature. When the +28 Volt Analog Temperature Telemetry Bus is ON, this telemetry voltage is an analog of the temperature of a point internal to Transmitter A located near the final RF power transistor. The analog relationship is independent of the SARR ON/OFF status. When the +28 Volt Analog Temperature Telemetry Bus is OFF, this telemetry voltage is 0 ± 0.5 volts.
- m. SARR Tx B Temperature. The description in para. (l.) above applies, substituting "B" for "A".
- n. SARR PTC A Temperature. When the +28 Volt Analog Temperature Telemetry Bus is ON, this telemetry voltage is an analog of the temperature of a point in the DC/DC converter in PTC "A". The analog relationship is independent of the SARR ON/OFF status. When the +28 Volt Analog Temperature Telemetry Bus is OFF, this telemetry voltage is 0 ± 0.5 volts.
- o. SARR PTC B Temperature. The description in para. (n.) above applies, substituting "B" for A.
- p. SARR Tx A Output Power. When Transmitter A is ON, this telemetry voltage is an analog of the RF power from the final RF power transistor to the low-pass filter and output isolator in Transmitter "A". When Transmitter "A" is OFF, this telemetry voltage is 0 ± 0.5 volts.
- q. SARR Tx B Output Power. The description in para. (p.) above applies, substituting "B" for "A".
- r. SARR 121.5 MHz/243 MHz Receiver A Local Oscillator Oven External Case Temperature. The Local Oscillator subassembly of the 121.5 MHz/243 MHz Receiver "A" assembly contains a crystal oscillator housed in a temperature-

controlled oven. When the +28 Volt Analog Temperature Telemetry Bus is ON, this telemetry voltage is an analog of the temperature of a point on the outside of the case of the temperature-controlled oven. The analog relationship is independent of the SARR ON/OFF status. When the +28 Volt Analog Temperature Telemetry Bus is OFF, this telemetry voltage is 0 ± 0.5 volts.

- s. SARR 121.5 MHz/243 MHz Receiver B Local Oscillator Oven External Case Temperature. The description in paragraph (r.) above applies, substituting "B" for "A".
- t. SARR 406.05 MHz Receiver A Local Oscillator Oven External Case Temperature. If the SARR contains a functional receiver in the 406.05 MHz Receiver A position, the description in paragraph (r.) applies, substituting "406.05 MHz" for "121.5 MHz/243 MHz". If the SARR contains a dummy in the 406.05 MHz Receiver A position, this telemetry voltage is 0.9 ± 0.5 volts when the +28 Volt Analog Temperature Telemetry Bus is ON, and 0 ± 0.5 volts when the +28 Volt Analog Temperature Telemetry Bus is OFF.
- u. SARR 406.05 MHz Receiver B Local Oscillator Oven External Case Temperature. The description of paragraph (t.) above applies, substituting "B" for "A".
- v. SARR Tx Baseplate Temperature. When the +28 Volt Analog Temperature Telemetry Bus is ON, this telemetry voltage is an analog of the temperature of a point near the center of the surface of the Transmitter Assembly Base Plate. The surface is that which faces the inside of the ESM. The analog relationship is independent of the SARR ON/OFF status. When the +28 Analog Temperature Telemetry Bus is OFF, this telemetry voltage is 0 ± 0.5 volts.

Table 3-8A. SARR Digital B Telemetry

Number	Telemetry Point Name	Digital B Channel Number	State	
			Logic "1" (0 volts)	Logic 0" (+ 5 volts)
1	SARR 121.5 MHz Redundancy Switch	257	A	B
2	SARR 243 MHz Redundancy Switch	281	A	B
3	SARR 406 MHz Redundancy Switch	305	A	B
4	SARR Tx Output RF Redundancy Switch	329	A	B

Table 3-8B. SARR Analog Telemetry

Number	Telemetry Point Name	Analog Telemetry Channel Number	Analog Subcom	Minor Frame
1	SARR Tx A RF Driver Current	385, 465	16-2	1, 81
2	SARR Tx B RF Driver Current	393, 473	16-2	9, 89
3	SARR PTC 28 Volt Input Monitor	401	6-2	17
4	SARR PTC A 16V Output Monitor	417	16-2	33
5	SARR PTC B 16 Volt Monitor	409	16-2	25
6	SARR 121.5 AGC Volts Rx A	425	16-2	41
7	SARR 121.5 AGC Volts Rx B	433	16-2	49
8	SARR 243 AGC Volts Rx A	441	16-2	57
9	SARR 243 AGC Volts Rx B	449	16-2	65
10	SARR 406 AGC Volts Rx A	457	16-2	73
11	SARR 406 AGC Volts Rx B	481	16-2	97
12	SARR Transmitter A Temperature	489	16-2	105
13	SARR Transmitter B Temperature	497	16-2	113
14	SARR PTC A Temperature	505	16-2	121
15	SARR PTC B Temperature	490	16-2	106
16	SARR Tx A Output Power	498	16-2	114
17	SARR Tx B Output Power	386	16-2	2
18	SARR 121/243 Receiver A Local Oscillator Oven External Case Temperature	394	16-2	10
19	SARR 121/243 Receiver B Local Oscillator Oven External Case Temperature	402	16-2	18
20	SARR 406 Receiver A Local Oscillator Oven External Case Temperature	410	16-2	26
21	SARR 406 Receiver B Local Oscillator Oven External Case Temperature	418	16-2	34
22	SARR Tx Baseplate Temperature	426	16-2	42

3.9 Solar Backscatter Ultraviolet Radiometer (SBUV/2)

3.9.1 Instrument Output Signals

The output data signals supplied by the instrument to the spacecraft fall into three categories Digital A (Radiometric) Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the SBUV/2 are detailed below.

3.9.2 Digital A Data

Digital A data is clocked into the spacecraft TIP whenever the Data Enable Pulse (A_1) is presented to the instrument.

3.9.2.1 General Requirements

Content: Instrument data (including any house-keeping telemetry required for reduction of observation data) is sampled at a constant 8.32 kb/sec rate by the SBUV/2 during those intervals allocated to SBUV/2 at a maximum equivalent rate of 320 bps.

Word Length: One SBUV/2 "word" or "sample" contains two contiguous 8-bit TIP words. Total length - 1.899 milliseconds.

Serial Output: MSB outputted first.

Standard Interface: Fast.

Interface Logic Element: CD4000A series.

Number of Minor Frame Words: Four words have been allocated to SBUV/2 per minor frame.

Minor Frame Word Locations: Words 36 and 37 plus words 80 and 81 of the minor frame are allocated to SBUV/2.

Content of Minor Frame Words: The bit information content and location of the Minor Frame Words are shown in Table 3-9A.

3.9.2.2 Operating Modes

Discrete Mode (Mode 1): The instrument will enter Mode 1 upon command during which time it views the earth's atmosphere (The majority of data is taken in this configuration) or the sun if the diffuser is deployed. In this mode radiometric data is taken at twelve discrete wavelengths and the program takes 32 seconds to complete. Data continues to be taken in this mode until the instrument is commanded into another mode.

If the grating drive fixed memory is selected, the Discrete Mode wavelengths are preselected. If the flex memory is selected, new wavelengths can be loaded into the memory and the instrument continues to take data at these wavelengths until the fixed memory is reselected or the instrument is turned off, which automatically erases the flex memory. The data format is shown in Table 3-9B. The submultiplexer locations are listed in Table 3-9C. A description of the status words is contained in Table 3-9D.

Sweep Mode (Mode 2): The instrument enters Mode 2 upon command during which time the grating sweeps from approximately 400 nm to 160 nm and data will be taken in 0.15 nm increments. If this instrument is viewing earth the scene spectral radiance is being measured, and if the diffuser is properly deployed the instrument is measuring the solar spectral irradiance. The Sweep Mode sequence takes 192 seconds to complete, and the instrument will continue to take data in this mode until commanded into another mode. The data format is shown in Table 3-9E. In the fixed memory the starting position of the sweep is preset at 406 nm, but if the flex memory is used the starting position can be set to any desired wavelength.

Wavelength Calibration Mode (Mode 3): The instrument enters Mode 3 upon command during which time the instrument views an on-board Hg (mercury) lamp source at 12 discrete grating positions bracketing a particular source line. The sequence is identical to Mode 1 in execution taking 32 seconds to complete, and the instrument continues to operate in this mode until commanded into another mode. The data format is shown in Table 3-9B.

Position Mode (Mode 4): The instrument enters this mode upon command during which time the grating will move to a preselected position and remain there until the instrument is commanded into another mode. The timing of this mode is, therefore, indefinite. Radiometric data is taken continuously as in Mode 1.

In Modes 3 and 4 the instrument will scan a preselected Hg line or gather data in a preselected wavelength, respectively, if the fixed memory is selected. If the flex memory is used, a different line or position can be selected.

3.9.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2-second subcoms generated by the TIP will sample each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

Words 8 and 12 of the Minor Frame are dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.9.3.1 Digital B Telemetry Points

Twenty-two Digital B Telemetry Points are required by the SBUV/2. The Digital B Telemetry Points provided by the SBUV/2 are shown in Table 3-9F. Detailed descriptions of each telemetry point are provided below.

3.9.4 Analog Telemetry

The Analog Telemetry is available at the instrument interface at all times. Three different subcoms (32, 16, and 1 seconds) generated by the TIP will be used to sample all spacecraft analog telemetry. All SBUV/2 Analog Telemetry will be outputted for the 16 second subcoms.

3.9.4.1 Analog Telemetry Points

The analog telemetry points provided by the SBUV/2 are shown in Table 3-9G. Descriptions of each telemetry point are detailed below.

A maximum of 17 analog channels will be utilized for housekeeping telemetry. A 16-second sampling period is used for any analog telemetry point.

3.9.4.2 Exceptions: None

The instrument output signals conform to Sections 3.1.6 and 3.1.8 of the GLIS.

Table 3-9A. SBUV/2 Data Format Discrete Mode

Line	TIP Minor	Function		Sample Time		Integration Interval	
(3)	Frames (2)	Word 1 (4)	Word 2 (4)	Word1 (7)	Word 2	Word 1	Word 2
L0	0, 10, 20,...310	Status Word 1	Range 1 Data	End of L0 Chan N-1	End of L9 Chan N-1	N/A	1 1/4 Sec and 1/4 Sec (8)
L1	1, 11, 21,...311	Status Word 2	Range 2 Data	Chan N-1	End of L9 Chan N-1	N/A	1 1/4 Sec and 1/4 Sec (8)
L2	2, 12, 22,...312	Analog Sub Mux	Range 3 Data	End of L0/L1 Chan N	End of L9 Chan N-1	0.1 Sec	1 1/4 Sec and 1/4 Sec (8)
L3	3, 13, 23,...313	Memory Verify	0000	End of L1 Chan N	N/A	N/A	N/A
L4	4, 14, 24,...314	Status Word 3	0000	Start of L0 Chan N	N/A	N/A	N/A
L5	5, 15, 25,...315	Status Word 4	0000	Start of L0 Chan N	N/A	N/A	N/A
L6	6, 16, 26,...316	Grating Position	0000	1/2 into L7 Alternates End of L9 Chan N-1	N/A	N/A	N/A
L7	7, 17, 27,...317	CCR Data	0000	End of L9 Chan N-1	N/A	1 1/4 Sec and 1/4 Sec (8)	N/A
L8	8, 18, 28,...318	RDCL/ GPE (6)	0000	End of L6/L7 Chan N	N/A	0.1 Sec	N/A
L9	9, 19, 29,...319	Frame Sync Code	0000	Start of L0 Chan N	N/A	N/A	N/A

Notes:

- (1) Includes discrete, calibration, and position modes.
- (2) Format is the same for all major frames.
- (3) The basic SBUV/2 data frame is a 20-word block repeating at one second intervals.
- (4) Word 1 corresponds to the 16 bits in TIP words 36 and 37, MSB first; Word 2 corresponds to the 16 bits in TIP words 80 and 81, MSB first.
- (5) Analog sub-mux is 16 channels deep.
- (6) Radiometric DC level/grating position error.
- (7) Channel N is the present 1 second time interval. Channel N-1 is the previous 1 second time interval.
- (8) In every two second interval, signal integration occurs between 3/4 and 2 seconds; the signal is sampled and readout at the end of 1 second and 2 seconds

**Table 3-9B. SBUV/2 Data Format Discrete Mode Detailed Description
(1 of 3)**

Name of Function	Format Location		Bit Numbers															
	Word	Line	MSB								LSB							
Frame Sync Code & Submultiplexer Channel Number	1	9	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Frame Sync Submultiplexer Channel Numbers															
Analog Sub Mux (See Table 3-9C for commutation scheme)	1	2	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
			Full scale counts 255 = 5.1V, all Analog Channels Channel A Channel B															
Radiometric DC Level/Grating Position Error (3)	1	8	Full scale counts: 255 = 5.1 Volts Note: RDCL F. S.Current: 91.5 pa															
Monochromatic Range Data	2		2 ¹⁵ 2 ⁰ Maximum Count = 65535 (1) Full Scale Counts = 65536															
			Full Scale Current Disc Sweep															
		0	Range 1 (2)								100 pa				1.25 na			
		1	Range 2 (2)								10 na				125 µa			
		2	Range 3 (2)								1 µa				12.5 µa			
Cloud Cover Radiometric Data	1	7	CCR								2.4 na				30 na			
Memory Verification	1	3	2 ¹² position data in memory								2 ⁰ S ₁ S ₀ F							
o Repeats every 128 sec.																		
o Reads memory as indicated by memory bits shown to right.																		
o Memory location read out in order starting with Word 0 segment 0 of fixed memory at TIP major frame pulse.																		
			Segment	S ₁		S ₀		Program		F								
			0	0		0		Fixed		1								
			1	0		1		Flex		0								
			2	1		0												
			3	1		1												

Notes:

- (1) Overflow flags (status 3 bits 1, 2, 3, 4).
- (2) Current referred to the PMT anode.
- (3) Grating Motor Current, Grating Position Error, and Grating Course Error are expected to always read 0 to 10 counts (telemetry points are grounded) and data should be disregarded.

**Table 3-9B. SBUV/2 Data Format Discrete Mode Detailed Description
(2 of 3)**

Temperature Monitors

1. Differential Monitors: $T_D = T_A - T_R$; $N_A = N_R + 0.1075 N_D - 13.7$ (1)

2. Single Pt Monitors:

Temp °C	Thermistor Ohms	Output Volts/Counts (N)				
		Shroud -30 to 80	Diff. A to B Reference	0 to 80°	-15 to 45°	-5 to 35°
-30	135.2	4.74/237				
-20	78.91K	4.57/228			5.15	
-15	61.02	4.45/222	3.58/179		5.01/250	
-10	47.54K	4.32/216	3.41/170	5.513	4.84/242	5.17
-5	37.31K	4.16/208	3.22/161			4.95/247
0	29.49K	3.99/199	3.01/150	4.98/249	4.42/221	4.70/235
5	23.46	3.79/189	2.79/140			
10	18.79	3.57/178	2.57/128	4.35/217	3.92/196	4.13/206
15	15.13	3.34/167	2.33/117			
20	12.26	3.10/155	2.11/105	3.67/183	3.36/168	3.52/176
25	10.00K	2.86/143	1.89/94	3.33/167	3.08/154	
30	8.194	2.61/130	1.68/84	3.00/150	2.79/139	2.90/145
3's	6.752	2.37/118	1.48/74			2.60/130
40	5.59	2.14/107	1.30/65	2.39/119	2.25/112	2.32/116
45	4.655K	1.91/95	1.14/57		2.01/100	
50	3.893K	1.71/85		1.86/93	1.78/89	1.82/91
60	2.7	1.35/67		.44/72	1.39/69	1.41/70
70	1.99K	1.05/52		.1/55	1.08/54	1.09/54
80	1.458	0.81/41		.85/42	.831/41	

(1) N_A = Thermistor "A" Temp in counts.

N_D = Differential Temp in counts.

N_R = Reference Temp in counts.

Table 3-9B. SBUV/2 Data Format Discrete Mode Detailed Description (3 of 3)

CMD Seq. State				
	2 ²	2 ¹	2 ⁰	
Discrete Sun	1-0	0	0	0
Command	1-1	0	0	1
Sequence	1-2	0	1	0
Disc. Sun Enable ON				
All Other States: Not Valid				
Sweep Sun	2-0	0	0	0
Command	2-1	0	0	1
Sequence	2-2	0	1	0
Step No.	2-3	0	1	1
Sweep Sun Enable ON				
All Other States: Not Valid				
W/L Cal 3-0	0	0	0	
Command	3-1	0	0	1
Sequence	3-2	0	1	0
Step No.	3-3	0	1	1
	3-4	1	0	0
	3-5	1	0	1
	3-6	1	1	0
	3-7	1	1	1
W/L Cal Enable ON				
All Other States: Not Valid				

Description of the CMD Sequence State Monitors

2², 2¹, and 2⁰

*W/L = wavelength

Timing Monitors

E Cal Step No.	16 Sec.	8 Sec.	4 Sec.	Retrace
A	1	0	0	
B	1	0	1	
C	1	1	0	
D	1	1	1	ON
1	0	0	0	
A	0	0	1	
A	0	1	0	
1	0	1	1	
E Cal		OFF		OFF

Description of the E Cal Step Decoding using Timing Monitors and the Retrace Monitor.

NOTE: Timing monitors are sampled at Channel N-1 (1 sec prior to readout).

Table 3-9C. SBUV/2 Data Format Discrete Mode Analog Sub-multiplexer Data Assignments

Bits 1 Thru 8 Channel A		Bits 9 Thru 16 Channel B	
Ch No.	Function	Ch No.	Function
CH1A	Chop Motor Curr	CH1B	Spare
CH2A	Diff Motor Curr	CH2B	Diffuser Plate Temp (1)
CH3A	HVPS Volts	CH3B	SM Baseplate Temp (2)
CH4A	Thermistor Bias (10V Ref)	CH4B	25V Pwr Volts
CH5A	Cal Lamp Temp (1)	CH5B	15V Servo Volts
CH6A	E Cal Ref Volts	CH6B	-15V Servo Volts
CH7A	15V Sensors Volts	CH7B	CCR Diode Temp (3)
CH8A	-15V Sensors Volts	CH8B	SM Differential Temp Y Axis (4)
CH9A	24V Motor Volts	CH9B	SM Differential Temp Z Axis (4)
CH10A	5V LED Volts	CH10B	Differential Ref Temp Z Axis
CH11A	10V Logic Volts	CH11B	Differential Ref Temp Y Axis
CH12A	Cal Lamp Curr	CH12B	PMT Cathode Temp (3)
CH13A	Spare	CH13B	Spare
CH14A	Signal Return	CH14B	Chopper Phase Error
CH15A	Signal Return	CH15B	Spare
CH16A	Lamp Motor Curr	CH16B	Spare

- (1) 0 to 80°C
- (2) -15 to 45°C
- (3) -5 to 35°C
- (4) $\pm 5^{\circ}\text{C}$

Table 3-9D. SBUV/2 Data Format Discrete Mode Digital A Status Word Descriptions (1 of 2)

		Assignment of Logic State	
Bit	Use	1 (GND)	0 (+10V)
Status Word #1			
1	Master Power	ON/OFF	OFF ON
2	Data Format	Sweep	Discrete
3	Sweep Mode Major Frame Word 2 ²	True	False
4	Sweep Mode Major Frame Word 2 ¹	True	False
5	Sweep Mode Major Frame Word 2	True	False
6	Retrace	ON	OFF
7	16 sec. (2 ²)	True	False
8	8 sec. (2 ¹)	True	False
9	4 sec. (2 ⁰)	True	False
10	CMD Seq. (2 ²)	True	False
11	CMD Seq. (2 ¹)	True	False
12	CMD Seq. (2 ⁰)	True	False
13	Range ID B-LO	ON	OFF
14	Range ID A-LO	ON	OFF
15	Range ID B-L1	ON	OFF
16	Range ID A-L1	ON	OFF
Status Word #2			
1	Range ID B-L2	ON	OFF
2	Range ID A-L2	ON	OFF
3	Range ID B-L3	ON	OFF
4	Range ID A-L3	ON	OFF
5	Range ID B-L4	ON	OFF
6	Range ID A-L4	ON	OFF
7	Range ID B-L5	ON	OFF
8	Range ID A-L5	ON	OFF
9	Range ID B-L6	ON	OFF
10	Range ID A-LED	ON	OFF
11	Range ID B-L7	ON	OFF
12	Range ID A-L7	ON	OFF
13	Range ID B-L8	ON	OFF
14	Range ID A-L8	ON	OFF
15	Range ID B-L9	ON	OFF
16	Range ID A-L9	ON	OFF

**Table 3-9D. SBUV/2 Data Format Discrete Mode Digital A Status Word Descriptions
(2 of 2)**

Assignment of Logic State			
Bit	Use	1 (GND)	0 (+10V)
Status Word 3			
1	R1 Over Range/On Scale	Over Range	On Scale
2	R2 Over Range/On Scale	Over Range	On Scale
3	R3 Over Range/On Scale	Over Range	On Scale
4	CCR Over Range/On Scale	Over Range	On Scale
5	Code Address B	1	0
6	Code Address B	1	0
7	Code Data 1	1	0
8	Code Data 2	1	0
9	Code Data 3	1	0
10	Code Data 4	1	0
11	Code Data 5	1	0
12	Code Data 6	1	0
13	Discrete Sun Enable	ON	OFF
14	Sweep Sun Enable	ON	OFF
15	Wavelength Calibration Enable	ON	OFF
16	SPARK		ALWAYS OFF
Status Word 4			
1	Diffuser Stow Position	Stow	Not Stowed
2	Diffuser Monitor Position	Monitor	Not Monitor
3	Diffuser Sun Position		Not Sun
4	Diffuser Decontam Position	Decontam	Not Decontam
5	Discrete Mode	ON	OFF
6	Sweep Mode	ON	OFF
7	Diffuser Position Valid	Valid	Not Valid
8	Diffuser Timer	Time Out	Not Time Out
9	Calib. Lamp Open	OPEN	NOT OPEN
10	Calib. Lamp Closed	CLOSED	NOT CLOSED
11	Calib. Lamp Position Valid	Valid	Not Valid
12	Calib. Lamp Timer	Time Out	Not Time Out
13	Calib. Mode	ON	OFF
14	Position Mode	ON	OFF
15	Grating Fix/Flex	FLEX	FLEX
16	Grating Index Found	Found	Not Found

Table 3-9E. SBUV/2 Data Format Sweep Mode

Line	Tiros Minor Frames			Sample Time		Integration Period	
		Word 1	Word 2	Word 1	Word 2	Word 1	Word 2
L0	0, 10, 20,...310	Status Word 1	Selected Range Data	Same as Discrete Modes (2)	End of L9	Same as Discrete Modes (1)	L9 (0.1 sec)
L1	1, 11, 21,...311	Status Word 2	Selected Range Data		End of L0		L0 (0.1 sec)
L2	2, 12, 22,...312	Analog Sub Mux	Selected Range Data		End of L1		L1 (0.1 sec)
L3	3, 13, 23,...313	Memory Verify	Selected Range Data		End of L2		L2 (0.1 sec)
L4	4, 14, 24,...314	Status Word 3	Selected Range Data		End of L3		L3 (0.1 sec)
L5	5, 15, 25,...315	Status Word 4	Selected Range Data		End of L4		L4 (0.1 sec)
L6	6, 16, 26,...316	Grating Position	Selected Range Data		End of L5		L5 (0.1 sec)
L7	7, 17, 27,...317	CCR Data	Selected Range Data		End of L6		L6 (0.1 sec)
L8	8, 18, 28,...318	RDCL/ GPE	Selected Range Data		End of L7		L7 (0.1 sec)
L9	9, 19, 29,...319	Frame Sync Code	Selected Range Data		End of L8		L8 (0.1 sec)

Notes:

- (1) CCR integration period: 1 second.
- (2) Sample time: end of L9, Channel N-1.

Table 3-9F. SBUV/2 Digital B Telemetry

No.	Telemetry Point Name	State*		Output Circuit Configuration
		Logic "1"	Logic "0"	
1	**Instrument Power On/Off	On	Off	
2	**Discrete CMD Yes/No	Yes	No	
3	**Sweep CMD Yes/No	Yes	No	
4	**Cal CMD Yes/No	Yes	No	
5	**Position CMD Yes/No	Yes	No	
6	HV On/Off	On	Off	
7	Motor Power On/Off	On	Off	
8	Lamp On/Off	On	Off	
9	Lamp Disabled/Enabled	Enable	Disable	
10	**Lamp Assy Open Cmd/Close Cmd	Open Cmd	Close Cmd	
11	HV Enabled/Disabled	Enabled	Disabled	
12	**Diff. Stow Cmd Yes/No	Yes	No	
13	**Diff. Mon. Cmd Yes/No	Yes	No	
14	**Diff. Sun Cmd Yes/No	Yes	No	
15	**Diff. Decontam Cmd Yes/No	Yes	No	
16	Ch Enc Sens Pri/Bkup	Pri	Bkup	
17	Cat Enc Sens Pri/Bkup	Pri	Bkup	
18	Diff Pos'n Sen Pri/Bkup	Pri	Bkup	
19	Lamp Pos'n Sen Pri/Bkup	Pri	Bkup	
20	**Grating Drive Fix/Flex	Fix	Flex	
21	Baseplate or Cal Lamp Htr ***On/Off	On	Off	
22	Diffuser Htr On/Off	On	Off	

* Logic "1" is a "True" or "Zero Voltage" state.

** Bit set indicates last command received at SBUV/2. Command action may or may not have been executed. For confirmation see Digital A status words one and four.

*** Cal Lamp Heater for NOAA-K,-L&-M

Table 3-9G. SBUV/2 Analog Telemetry

No.	Telemetry Point Name	Range	Resolution
1	SM Baseplate Temp #2 (1)	(2)	N/A (5)
2	SM Shroud Temp.	(3)	N/A (5)
3	Depolarizer Housing Temp.	(2)	N/A (5)
4	HVPS Temp.	(2)	N/A (5)
5	Diffuser Plat Temp #2 (1)	(4)	N/A (5)
6	Chopper Motor Temp.	(2)	N/A (5)
7	Grating Motor Temp.	(2)	N/A (5)
8	Diffuser Motor Temp.	(2)	N/A (5)
9	Cal Lamp Motor Temp.	(2)	N/A (5)
10	Electrometer Temp.	(2)	N/A (5)
11	Cal. Lamp Pwr. Supply Temp.	(2)	N/A (5)
12	Diffuser Radiator Temp.	(2)	N/A (5)
13	ELM Temp.	(2)	N/A (5)
14	LVPS Temp.	(2)	N/A (5)
15	Diffuser Heater Current†	0.17A nominal	0.1 A/V
16	Baseplate Heater Current*	0.17A nominal	0.1 A/V
17	Cal Lamp Heater Current *	0.17A nominal	0.1 A/V
18	28V Main Power (7)	28V nominal	9.912V/V

(1) Powered from the 28V Analog TM Bus

(2) -15 to 45°C

(3) -30 to 80°C

(4) 0 to 80°

(5) Temperature monitors are nonlinear

(6) This telemetry point senses the +28V power line prior to instrument On/Off relay.

* Cal Lamp Heater on NOAA-K, -L, & -M.

† Output grounded on NOAA-K, -L, & -M.

3.10 Space Environment Monitor (SEM-2)

3.10.1 Instrument Output Signals

The SEM instrument does not conform to the output signal requirements of Section 3.1.5 of the GLIS. The Digital A data is inverted with respect to the description given in the GLIS.

The output data signals supplied by the instrument to the spacecraft are assigned into three categories; Digital A Data, Digital B Telemetry, and Analog Telemetry. The specific signals supplied by the SEM-2 are as detailed below. However, as stated above, the digital A data is inverted.

3.10.2 Digital A Data

Digital A data will be clocked into the spacecraft TIP whenever the Data Enable Pulse (A1) is presented to the instrument. Details of the Digital A timing and interface characteristics are shown in Section 3.1.8 of the GLIS.

3.10.2.1 General Requirements

Instrument Data

- a. **Content:** The data is categorized by source (MEPED, TED), type (ions, protons, electrons, alpha particles), energy level, detector pointing direction, and digital status or analog telemetry. All data output and repetition rates are in the format shown in Tables 3-10B, 3-10C, and 3-10D.

All science data is in compressed format. See Table 3-10A, Note 3 for conversion of compressed values to counts. The details of the MEPED and TED Digital A particle energy data channels and instrument telemetry are as described in the SEM-2 Design Report document, TBD.

- b. **Word Length:** 8-bits (one TIP Word)
- c. **Serial Output:** MSB is outputted first
- d. **Standard Interface:** Fast CMOS
- e. **Number of Minor Frame Words:**

Two 8-bit TIP words are required each minor frame.

SEM Digital A data are assigned to minor frame words 20 and 21.

Calibration Data

The SEM-2 instrument provides an In Flight Calibration (IFC) for the MEPED and TED. The IFC is initiated by the first Major Frame Sync pulse (32 seconds maximum) following receipt of the MEPED IFC ON or TED IFC ON command. The IFC may be run separately or concurrently. The initiation of the IFC is indicated in both Digital A and B telemetry status indicators. Refer to Table 3-10E. The Digital A Bi-Level Status indication, IFC ON shall occur in Minor Frame 240 in the first Major Frame subsequent to the start of the IFC.

Termination of an IFC is accomplished by the instrument timing or with the appropriate MEPED/TED IFC TERMINATE commands. Instrument commands received during an IFC are stored for implementation at the completion of the IFC with the exception of the terminate command previously described. Upon termination of the IFC, the MEPED and TED modes return to either the pre-IFC or last commanded state.

IFC Timing

The MEPED IFC is comprised of two phases, Phase 0 and 1, each lasting 192 seconds, 6 Major Frames. The TED IFC shall also be comprised of two phases, 0 and 1. Phase 0 is comprised of 4 segments, each segment lasting 8 seconds. Phase 1 shall last for 192 Major Frame Sync periods, 101.33 minutes.

IFC Format

The Digital A data output format during IFC is the same as the normal data format as shown in Table 3-10A.

During Phases 0 and 1 the MEPED shall generate a 192 step ramp voltage, resetting to 0 at the end of each phase. The IFC ramp pulse is generated in two seconds off, two seconds on, sets to allow continuous measurement of the solid state detector background counts during the off state.

Table 3-10A. SEM-2 Output Format in Minor Frame (1 of 2)

0.1 Sec	0 CK SH OP1	20 TED SWP V AH Sub 5	40 TED E CEM HV	60 TED P CEM HV	80 MEP OMN I BV	100 AN Sub 1	120 AN Sub 2	140 AN Sub 3	160 AN Sub 4	180 TED IFC V	200 MEP IFC V	220 BL 1	240 BL 2	260 BL Sub	280 OEB KH	300 3EB KH	House Keeping		
	1 OP2 OP3	21 - -	41 - -	61 - -	81 - -	101 - -	121 - -	141 - -	161 - -	181 - -	201 - -	221 - -	241 - -	261 - -	281 - -	301 - -			
	2 OP4 OP5	22 - -	42 - -	62 - -	82 - -	102 - -	122 - -	142 - -	162 - -	182 - -	202 - -	222 - -	242 - -	262 - -	282 - -	302 - -		MEPED 0° Tele- scope	
	3 OP6 OE1	23 - -	43 - -	63 - -	83 - -	103 - -	123 - -	143 - -	163 - -	183 - -	203 - -	223 - -	243 - -	263 - -	283 - -	303 - -			
	4 OE2 OE3	24 - -	44 - -	64 - -	84 - -	104 - -	124 - -	144 - -	164 - -	184 - -	204 - -	224 - -	244 - -	264 - -	284 - -	304 - -			
	5 9P1 9P2	25 - -	45 - -	65 - -	85 - -	105 - -	125 - -	145 - -	165 - -	185 - -	205 - -	225 - -	245 - -	265 - -	285 - -	305 - -			
	6 9P3 9P4	26 - -	46 - -	66 - -	86 - -	106 - -	126 - -	146 - -	166 - -	186 - -	206 - -	226 - -	246 - -	266 - -	286 - -	306 - -			MEPED 90° Tele- scope
	7 9P5 9P6	27 - -	47 - -	67 - -	87 - -	107 - -	127 - -	147 - -	167 - -	187 - -	207 - -	227 - -	247 - -	267 - -	287 - -	307 - -			
	8 9E1 9E2	28 - -	48 - -	68 - -	88 - -	108 - -	128 - -	148 - -	168 - -	188 - -	208 - -	228 - -	248 - -	268 - -	288 - -	308 - -			
	9 9E3 P6	29 - -	49 - -	69 - -	89 - -	109 - -	129 - -	149 - -	169 - -	189 - -	209 - -	229 - -	249 - -	269 - -	289 - -	309 - -			

Table 3-10A. SEM-2 Output Format in Minor Frame (2 of 2)

10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310] MEPED] OMNI
P7	-	-	-	-	AN	-	-	-	-	-	-	-	-	-	-	
P8	P9	P8	P9	P8	Sub 1	P8	P9	P8	P9	P8	P9	P8	P9	P8	P9	
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311] TED] Differ--] ential
OP2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OP3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312] Energy
OP4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OP5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13	33	53	73	93	113	133	143	173	193	213	233	253	273	293	313] TED] Low] Energy
OP6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OE1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
14	34	54	74	94	114	134	144	174	194	214	234	254	274	294	314] Flux
OE2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OE3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
15	35	55	75	95	115	135	145	175	195	205	235	255	275	295	315] TED] High] Density
9P1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9P2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
16	36	56	76	96	116	136	156	176	196	206	236	256	276	296	316] Flux
9P3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9P4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
17	37	57	77	97	117	137	157	177	197	207	237	257	277	297	317] TED] Peak] Flux
9P5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9P6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
18	38	58	78	98	118	138	158	178	198	208	238	258	278	298	318] TED] Peak] Flux
9E1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9E2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319]
9E3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
P6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2 S 4		Sec		8 Sec		16 Sec		24 Sec		32 Sec						

Notes (Table 3-10A)

1. Notation as follows:

Minor Frame Number——	0	20	40	60	80	100	280	300
Data in Word 20——	CKSM	TED SWP V AH (SUB 5)	TED E CDEM HV	TED P CDEM HV	MEP OMNI BV	AN SUB 1	OEBKH	3EBKH
Data in Word 21——	OPI	-	-	-	-	-	-	-

2. Dashes indicate data is the same as in previous column.

3. The minimum (MIN) count for the compressed (COMPR) telemetered value is determined as follows:

- a) If the compressed value is equal to or less than 32, the minimum count is equal to the compressed value, i.e.,

$$\text{COMPR} \leq 32, \text{ MIN} = \text{COMPR}$$

- b) If the compressed value is greater than 32, the minimum count algorithms is:

$$C1 = \text{COMPR} - 32, \text{ EM} = C1/14$$

$$M1 = C1 - (14 * \text{EM})$$

$$\text{for } M1 \leq 10, M2 = 2 * M1$$

$$\text{for } M1 > 10, M2 = (3 * M1) - 10$$

$$\text{MIN} = (M2 + 32) * 2\text{EM}$$

4. Compressed values are in the range of 0 to 255, counts are in the range of 0 to 1998878.

5. The MIN count for a specific compressed value COMPR n is the range of counts MIN n to MIN (n +1) - 1. The following illustrates the range of values for MIN:

	<u>COMPR</u>	<u>MIN</u>	<u>RANGE</u>
n	51	84	84-87
n+1	52	88	88-91
	53	92	92-95

Table 3-10B. SEM-2 Digital A Data Sample Rates

MEPED Digital A Data					
Particle Type	Sensor	Detected Energy Range	Readout Time (Sec)	Mnemonic	Notes*
Proton	Telescope	30-80 keV	2	OP1, 9P1	
	0/90°	80-250 keV	2	OP2, 9P2	
		250-800 keV	2	OP3, 9P3	
		800-2500 keV	2	OP4, 9P4	
		2500-7000 keV	2	OP5, 9P5	
		>7000 keV	2	OP6, 9P6	
Electron	Telescope	≥ 30 keV	2	OE1, 9E1	
	0/90°	≥ 100 keV	2	OE2, 9E2	
		≥ 300 keV	2	OE3, 9E3	
Proton	Omnidirectional	≥ 16 MeV	2	P6	
		≥ 35 MeV	2	P7	
		≥ 70 MeV	4	P8	
		≥ 140 MeV	4	P9	

TED Digital A Data			
Definition (1)	Readout Time (Sec)	Mnemonics	Notes*
Partial Energy Flux (0.05-1 keV)	2	OEFL, OPFL, 3EFL, 3PFL	1
Partial Energy Flux (1-20 keV)	2	OEFH, OPFH, 3EFH, 3PFH	1
Maximum Differential Energy Flux	2	ODEM, ODPM, 3DEM, 3DPM	
Energy of Maximum Differential Energy Flux	2	OEM, OPM, 3EM, 3PM	2
Four-Point Energy/Flux spectrum	8	0DE1, 0DE2, 0DE3, 0DE4 3DE1, 3DE2, 3DE3, 3DE4 0DP1, 0DP2, 0DP3, 0DP4 3DP1, 3DP2, 3DP3, 3DP4	3, 4
Background	32	0EBKH, 0EBKL, 0PBKH, 0PBKL 3EBKH, 3EBKL, 3PBKH, 3PBKL	

Notes: (Table 3-10B)

- (1) Four sets of measurements are made: electrons at 0°, protons at 0°, electrons at 30°, and protons at 30°.
- (2) Four bits each, combined into two data words (OEM/OPM and 3EM/3PM).
- (3) Differential energy channels 4, 8, 11, and 14.
- (4) The four-point proton spectra are telemetered three times every 32 seconds.

Table 3-10C. SEM-2 Digital A 32 Second Analog Telemetry A

Readout Time = 32 Seconds					
Minor Frame	Word	Mnemonic	Data Assignment	Source	Notes
20	20	TED SWP V (AN SUB 5)	TED Sweep Voltage Monitor (Analog Subcommutator 5)	TED	1
40	20	TED E CDEM HV	TED Electron CDEM High Voltage Monitor	TED	1
60	20	TED P CDEM HV	TED Proton CDEM High Voltage Monitor	TED	1
80	20	MEP OMNI BV	MEP Omnidirectional Sensor Bias Voltage Monitor	MEP	1
100	20	AN SUB 1	Analog Subcommutor 1	See Table 3-10D	
120	20	AN SUB 2	Analog Subcommutor 2	See Table 3-10D	
140	20	AN SUB 3	Analog Subcommutor 3	See Table 3-10D	
160	20	AN SUB 4	Analog Subcommutor 4	See Table 3-10D	
180	20	TED IFC V	TED IFC Ramp Voltage Monitor	TED	
200	20	MEP IFC V	MEP IFC Ramp Voltage Monitor	MEP	
NOTE					
(1) Also in TIP 32 second analog telemetry.					

Table 3-10D. SEM-2 Digital A Analog Subcommutator Telemetry (1 of 2)

(Readout Time - 512 Seconds) (Data points are read every 256 seconds since they are read twice per subcommutator main frame Analog)							
Minor Frame	Word	Analog Subcommutator		Mnemonic	Data Assignment	Source	Notes
		Number	Frame				
100	20	1	1, 9	uP SYS A +5V	Microprocessor System A +5 Volts Monitor	DPU	1
100	20	1	2, 10	uP SYS B +5V	Microprocessor System B +5 Volts Monitor	DPU	1
100	20	1	3, 11	DPU +5V	DPU +5 Volts Monitor	DPU	
100	20	1	4, 12	DPU +10V	DPU +10 Volts Monitor	DPU	
100	20	1	5, 13	DPU +6V	DPU +6 Volts Monitor	DPU	
100	20	1	6, 14	DPU -6V	DPU -6 Volts Monitor	DPU	
100	20	1	7, 15	DPU TEMP	DPU Temperature Monitor	DPU	
100	20	1	8, 16	DPU REF	DPU DAC Reference Voltage Monitor	DPU	
120	20	2	1, 9	MEP +6.5V	MEP +6.5 Volts Monitor	MEP	
120	20	2	2, 10	MEP +7.5V	MEP +7.8 Volts Monitor	MEP	
120	20	2	3, 11	MEP -7.5B	MEP -7.8 Volts Monitor	MEP	
120	20	2	4, 12	MEP +5V	MEP +5 Volts Monitor	MEP	1
120	20	2	5, 13	MEP +6V	MEP +6 Volts Monitor	MEP	
120	20	2	6, 14	MEP -6V	MEP -6 Volts Monitor	MEP	
120	20	2	7, 15	MEP P TEL BV	MEP Proton TEL Bias Voltage Monitor	MEP	
120	20	2	8, 16	MEP E TEL BV	MEP Electron TEL Bias Voltage Monitor	MEP	
140	20	3	1, 9	MEP IFC REF	MEP IFC Reference Voltage Monitor	MEP	
140	20	3	2, 10	MEP 0 DEG REF	MEP 0°, D4, D5 Sensor Threshold Reference Voltage Monitor	MEP	
140	20	3	3, 11	MEP 90 DEG REF	MEP 90°, D6, D7 Sensor Threshold Reference Voltage Monitor	MEP	
140	20	3	4, 12	MEP P TEL TEMP	MEP Proton TEL Temperature Monitor	MEP	
NOTE							
Also in TIP 32 second analog telemetry.							

Table 3-10D. SEM-2 Digital A Analog Subcommutator Telemetry (2 of 2)

(Readout Time - 512 Seconds) (Data points are read every 256 seconds since they are read twice per subcommutator main frame Analog						
Minor Frame	Word	Analog Subcommutator		Mnemonic	Data Assignment	Source
		Number	Frame			
140	20	3	5, 13	MEP E TEL TEMP	MEP Electron TEL Temperature Monitor	MEP
140	20	3	6, 14	MEP OMNI TEMP	MEP Omni Sensor Temperature Monitor	MEP
140	20	3	7, 15	MEP ELEC TEMP	MEP Electronics Temperature Monitor	MEP
140	20	3	8, 16	TED TEMP	TED Temperature Monitor	TED
160	20	4	1, 9	TED +8V	TED +8 Volts Monitor	TED
160	20	4	2, 10	TED +5V	TED +5 Volts Monitor	TED
160	20	4	3, 11	TED -6V	TED -6 Volts Monitor	TED
160	20	4	4, 12	TED +30V	TED +30 Volts Monitor	TED 1
160	20	4	5, 13	TED -30V	TED -30 Volts Monitor	TED
160	20	4	6, 14	TED +100V	TED +100 Volts Monitor	TED
160	20	4	7, 15	TED -1000V	TED -1000 Volts Monitor	TED
160	20	4	8, 16	TED IFC REF	TED IFC Reference Voltage Monitor	TED
20	20	5	1, 9	TED SWP V 1	TED Sweep Voltage Monitor, Step 0 of 255	TED 1
20	20	5	2, 10	TED SWP V 2	TED Sweep Voltage Monitor, Step 32 of 255	TED 1
20	20	5	3, 11	TED SWP V 3	TED Sweep Voltage Monitor, Step 64 of 255	TED 1
20	20	5	4, 12	TED SWP V 4	TED Sweep Voltage Monitor, Step 96 of 255	TED 1
20	20	5	5, 13	TED SWP V 5	TED Sweep Voltage Monitor, Step 128 of 255	TED 1
20	20	5	6, 14	TED SWP V 6	TED Sweep Voltage Monitor, Step 160 of 255	TED 1
20	20	5	7, 15	TED SWP V 7	TED Sweep Voltage Monitor, Step 192 of 255	TED 1
20	20	5	8, 16	TED SWP V 8	TED Sweep Voltage Monitor, Step 224 of 255	TED 1
<p style="text-align: center;">NOTE</p> <p>The eight Digital A Sweep Voltage Monitors are sweep correlated samples of the TED Sweep Voltage Analog Monitor Output (TED SWP V), which is a continuous monitor of the TED Sweep Voltage.</p> <p>Also in TIP 32 second analog telemetry.</p>						

Table 3-10E. SEM-2 Digital A Bi-level Telemetry Data

Minor Frame	Word	Bit	Mnemonic	Data Assignment	Source	Also Provided As Digital B	Notes
220	20	1	SUB FC1		DPU		1
220	20	2	SUB FC2		DPU		1
220	20	3	SUB FC3		DPU		1
220	20	4	SUB FC8		DPU		1
220	20	5	ERR FLAG		DPU		2
220	20	6					
220	20	7					
220	20	8	uP SYS ID		DPU	X	3
240	20	1	e PHD LSB	TED e Discriminator Control LSB	DPU	X	4
240	20	2	e PHD MSB	TED e Discriminator Control MSB	DPU	X	4
240	20	3	p PHD LSB	TED p Discriminator Control LSB	DPU	X	4
240	20	4	p PHD MSB	TED p Discriminator Control MSB	DPU	X	4
240	20	5	TED IFC	TED IFC Status	TED	X	5
240	20	6	TED IFC PU	TED IFC Pulser Status	TED		6
240	20	7	MEP IFC	MEPED IFC Status	MEP	X	5
240	20	8	MEP IFC PH	MEPED IFC Phase	MEP		7
260	20	1-8	BL SUB	Bi-Level Subcommutator			See Table 3-10F

Notes:

1. The SEM Digital A subcommutator frame counter is synchronized to the TIP 32 second Major Frame Pulse. The counter shall cycle from 0 to 15 counts through 16 major frame periods, a total of 512 seconds. The counter shall identify the content of the subcommutated bi-level status and analog telemetry words.
2. 0 = no error, 1 = error
3. 0 = _u PA, 1 = _u PB

4. PHD level decoded as follows:

Bit 1	Bit 2	
0	0	e PHD Level 0
0	1	e PHD Level 1
1	0	e PHD Level 2
1	1	e PHD Level 3

Bit 3	Bit 4	
0	0	p PHD Level 0
0	1	p PHD Level 1
1	0	p PHD Level 2
1	1	p PHD Level 3

5. 0 = IFC OFF, 1 = IFC ON
6. 0 = PULSER OFF, 1 = PULSER ON
7. 0 = PHASE 0, 1 = PHASE 1

Table 3-10F. SEM-2 Digital A Bi-level Subcommutator Telemetry (1 of 2)

(Readout Time = 512 Seconds)							
Minor Frame	Word	Bi-Level Subcom		Mnemonic	Data Assignment	Source	Notes
		Number	Frame				
260	20	1	0	CDEM HV STAT	TED CMD HVPS Status	DPU	
260	20	1	1	uP WD CNT	Active uP System Watchdog Counter	DPU	
260	20	1	2	LAST CMD	Last Level Command Received	DPU	
260	20	1	3	SYS TEST 1	System Test Status 1	DPU	
260	20	1	4	TED PLUG 1	TED PLUG Byte 1	DPU	
260	20	1	5	TED PLUG 2	TED PLUG Byte 2	DPU	
260	20	1	6	TED PLUG 3	TED PLUG Byte 3	DPU	
260	20	1	7	TED PLUG 4	TED PLUG Byte 4	DPU	
260	20	1	8	CDEM HV STAT	TED CDEM HVPS Status	DPU	
260	20	1	9	uP WD CNT	Active uP System Watchdog Counter	DPU	
260	20	1	A	LAST CMD	Last Level Command Received	DPU	
260	20	1	B	SYS TEST 2	System Test Status 2	DPU	
260	20	1	C	ROM1 CKS	Active uP System ROM1 Checksum	DPU	
260	20	1	D	ROM2 CKS	Active uP System ROM 2 Checksum	DPU	
260	20	1	E	ADCLO	A to D Converter 50% Cal, Low Z	DPU	
260	20	1	F	ADCHI	A to D Converter 50% Cal, High Z	DPU	

Table 3-10F. SEM-2 Digital A Bi-level Subcommutator Telemetry (2 of 2)

(Readout Time - 512 Seconds) (Frame 1/9 Data points are read every 256 seconds since they are read twice per subcommutator main frame)								
Minor Frame	Word	Bi-Level Subcom			Mnemonic	Data Assignment	Source	Notes
		Number	Frame	Bit				
260	20	1	1, 9	1	E HV CTR 1	TED Electron CDEM VPs Control 2**0	DPU	1
260	20	1	1, 9	2	E HV CTR 2	TED Electron CDEM HVPS Control 2**1	DPU	1
260	20	1	1, 9	3	E HV CTR 4	TED Electron CDEM HVPS Control 2**2	DPU	1
260	20	1	1, 9	4	P HV CTR 1	TED Proton CDEM HVPS Control 2**0	DPU	1
260	20	1	1, 9	5	P HV CTR 2	TED Proton CDEM HVPS Control 2**1	DPU	1
260	20	1	1, 9	6	P HV CTR 4	TED Proton CDEM HVPS Control 2**2	DPU	1
260	20	1	1, 9	7		Spare		
260	20	1	1, 9	8		Spare		
260	20	1	4	1	MFS ERR	Major Frame Sync Error	DPU	2
260	20	1	4	2	DIG A ERR	Digital A Data Control Error	DPU	2
260	20	1	4	3	DATA ERR	Data Accumulation Interval Error	DPU	2
260	20	1	4	4	SER LNK ERR	TED Serial Link Parity Error	DPU	2
260	20	1	4	5	PWR UP ERR	Power Up Error	DPU	2
260	20	1	4	6	CMD ERR	Command Processing Error	DPU	2
260	20	1	4	7	RWM TST ERR	Active UP System Read Write Memory Test Error	DPU	2
260		1	4	8	WD ERR	Active UP System Watchdog Error	DPU	2
260	20	1	12	1	TED PLUG ERR	TED Configuration Plug Decode Error	DPU	2
260	20	1	12	2	SUB INT ERR	Sub-Interval Time - Out Error	DPU	2
260	20	1	12	3	CTR OVF ERR	Compression Count Overflow	DPU	2
260	20	1	12	4-8	SPARE			

Notes: (Table 3-10F)

1. GEM HVPS control bits decoded as follows:

BIT	BIT	BIT		
1	2	3		
4	5	6		
0	0	0	LEVEL	0
0	0	1	LEVEL	1
0	1	0	LEVEL	2
0	1	1	LEVEL	3
1	0	0	LEVEL	4
1	0	1	LEVEL	5
1	1	0	LEVEL	6
1	1	1	LEVEL	7

2. 0 = No Error, 1 = Error

3.10.3 Digital B Telemetry

The Digital B one-bit status telemetry is available at the instrument interface at all times. The 3.2 second subcom generated by the TIP will sample each Digital B Telemetry Point once every 3.2 seconds. The characteristics of the Digital B telemetry interface are detailed in Section 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

Word 8 of the Minor Frame is dedicated to the sampling of Digital B Telemetry from all spacecraft components.

3.10.3.1 Digital B Telemetry Points

The Digital B Telemetry Points provided by the SEM are in Table 3-10G. SEM-2 Digital B Telemetry Points 1 through 7 are included in the SEM-2 Digital A data.

3.10.4 Analog Telemetry

The Analog Telemetry is available at the instrument interface at all times. Three different subcoms (32, 16 and 1-second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the GLIS.

3.10.4.1 Analog Telemetry Points

The analog telemetry points provided by the SEM are in Table 3-10H. SEM-2 Analog Telemetry Points 1 through 9 are included in the SEM Digital A Data.

Table 3-10G. SEM-2 Digital B Telemetry

No.	Telemetry Point	Logic State*		Minor Frame/Bit	Chan.
		"0"	"1"		
1	uP System ID	uPA	uPB	26/1	26
2	TED e PHD MSB (1)	0	1	26/5	154
3	TED e PHD LSB (1)	0	1	26/4	122
4	TED p PHD MSB (1)	0	1	27/3	91
5	TED p PHD LSB (1)	0	1	27/4	123
6	TED IFC	Off	On	26/2	58
7	MEPED IFC	Off	On	26/3	90
8	uP A Watch Dog Timer	Fault	Normal	27/1	27
9	uP B Watch Dog Timer	Fault	Normal	27/2	59

Notes:

1.	MSB	LSB	PHD Level
	0	0	0
	0	1	1
	1	0	2
	1	1	3

Table 3-10H. SEM-2 Analog Telemetry

No.	Telemetry Data	(1) Subcom	Minor Frame	Ch. #	Range
1	Microprocessor A +5V	16AN	4/164	294	
2	Microprocessor B +5V	16AN	108/268	492	
3	DPU +5V Monitor	16AN	2/162	326	
4	MEPED +5V Monitor	16AN	3/163	318	
5	TED +5V Monitor	16AN	96/256	302	
6	TED Sweep Voltage	16AN	97/257	310	
7	TED e CDEM High Voltage	32AN	230	230	
8	TED p Cem High Voltage	32AN	222	222	
9	MEPED Omni Bias Voltage	32AN	214	214	
10	MEPED Elect. Temp. (2)	32AN	143/303	143	
11	MEPED p Sensor Temp. (2)	32AN	135/295	135	
12	TED Temperature (2)	32AN	127/287	127	
13	DPU Temperature (2)	32AN	119/279	119	

(1) 16AN, 32AN are 16 and 32 second sample periods, respectively.

(2) Powered by +28V Analog Telemetry bus.

Abbreviations and Acronyms

AIP	AMSU information Processor
AMSU	Advanced Microwave Sounder Unit
APT	Automatic Picture Transmission
AVHRR	Advanced Very High Resolution Radiometer
DCS	Data Collection System
DRU	Data Recovery Unit
GAC	Global Area Coverage
GIIS	General Instrument Interface Specification
HIRS	High Resolution Infrared Radiation Sounder
HRPT	High Resolution Picture Transmission
LAC	Local Area Coverage
MIRP	Manipulated Information Rate Processor
MSU	Microwave Sounding Unit
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data and Information Service
NOAA	National Oceanic and Atmospheric Administration
SBUV	Solar Backscatter Ultraviolet Radiometer
SARP	Search and Rescue Processor
SARR	Search and Rescue Repeater
SEM	Space Environment Monitor
SSU	Stratospheric Sounding Unit
TIP	TIROS Information Processor
TIROS	Television Infrared Observation Satellite
TIROS-N	Advanced TIROS